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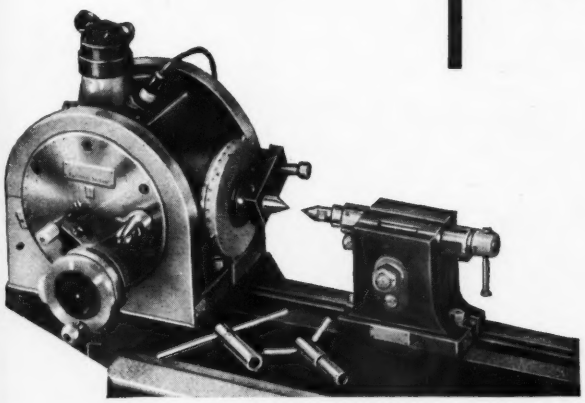

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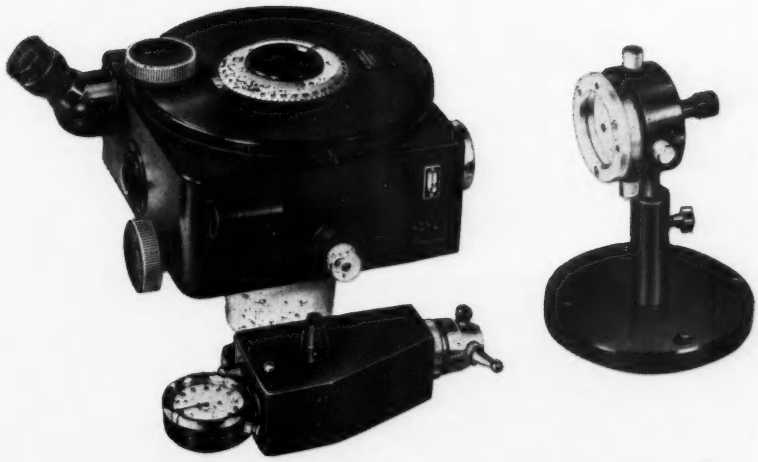

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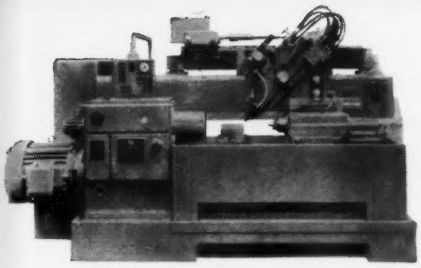

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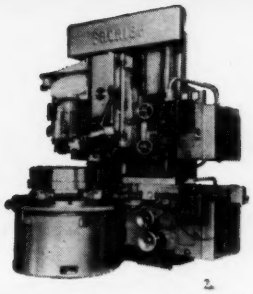

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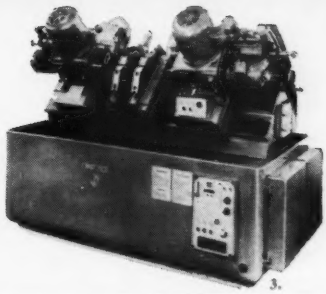

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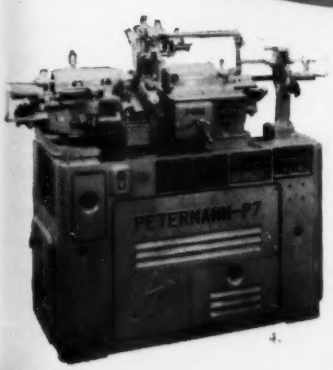

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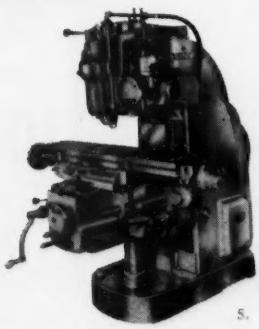

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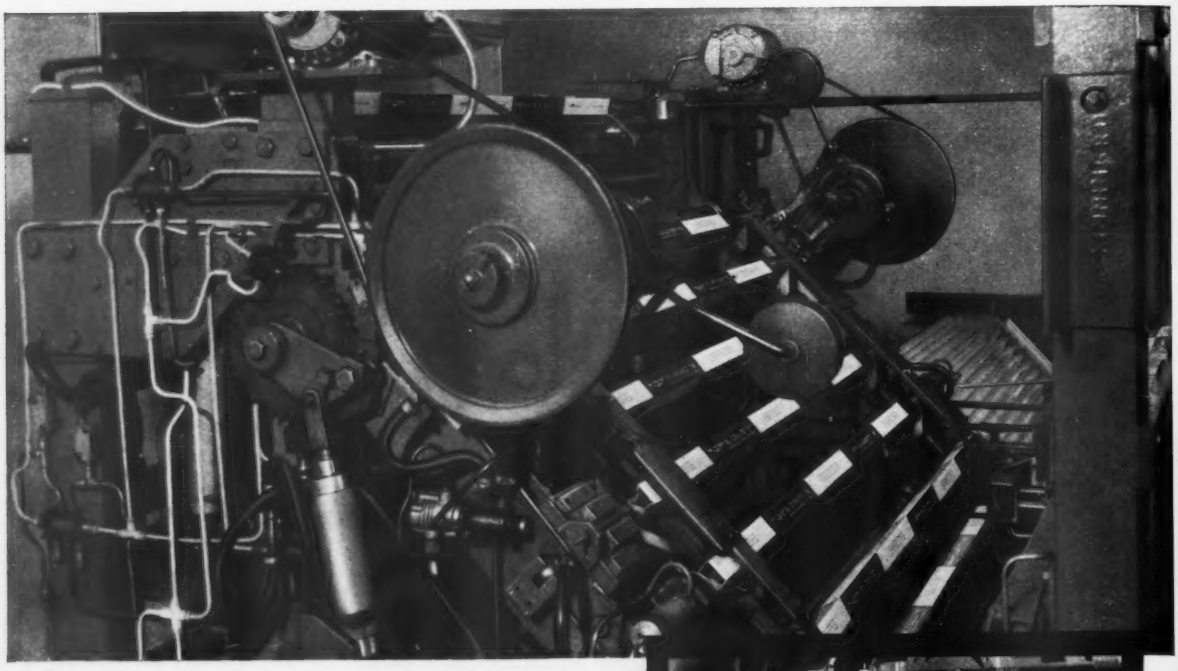

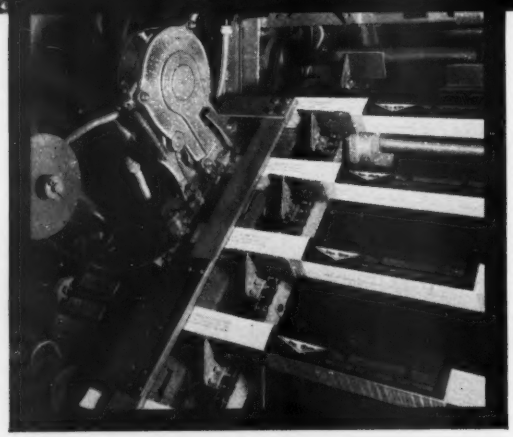

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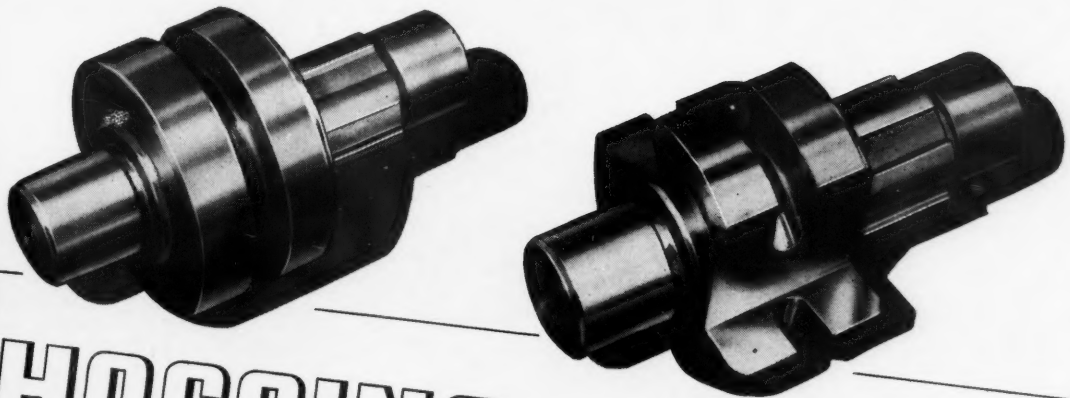

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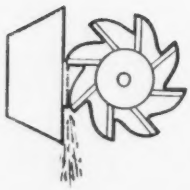

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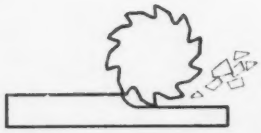

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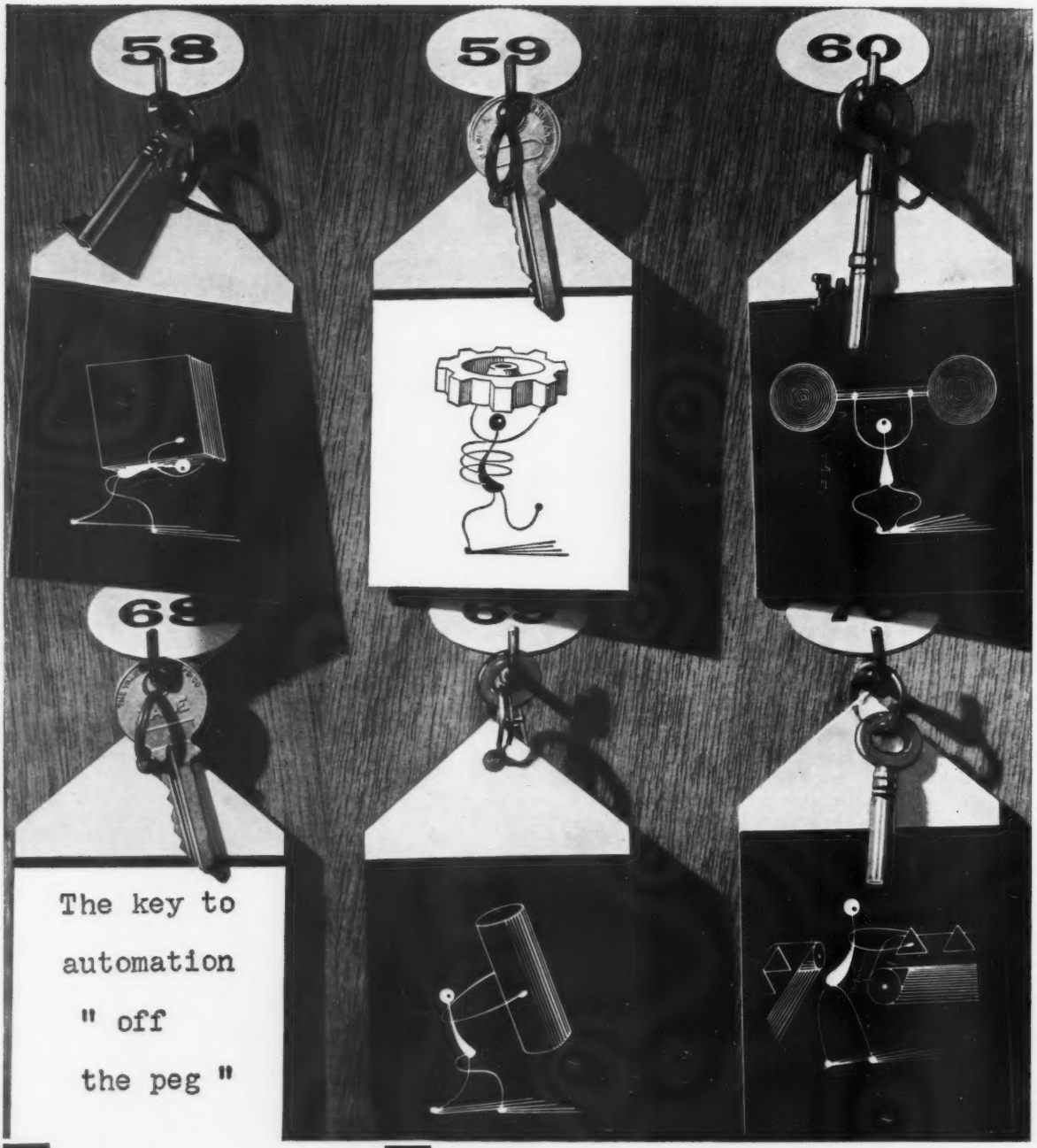

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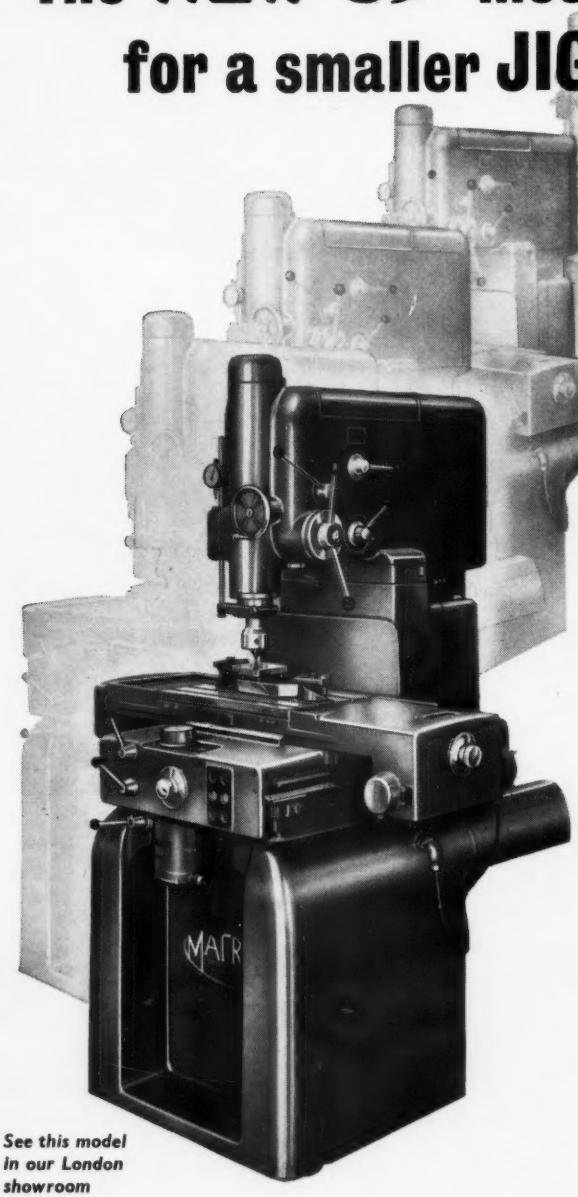

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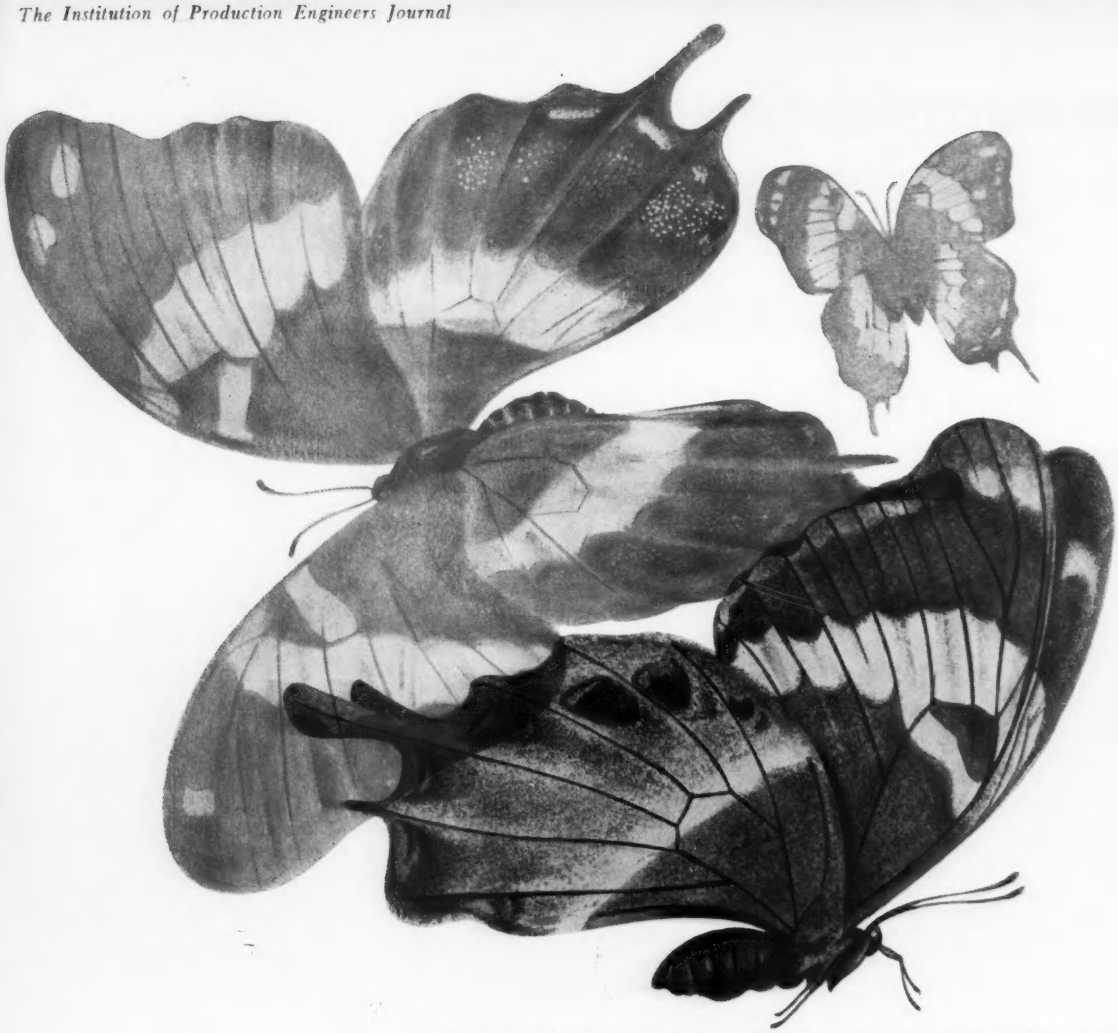

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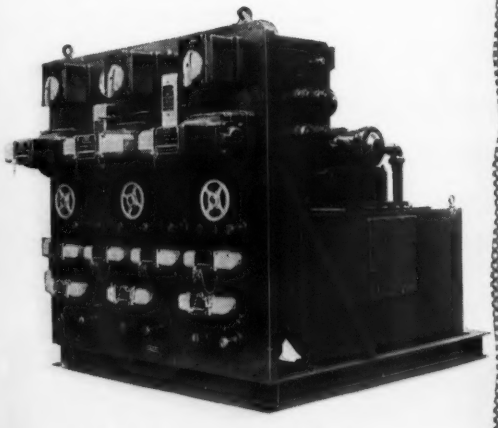

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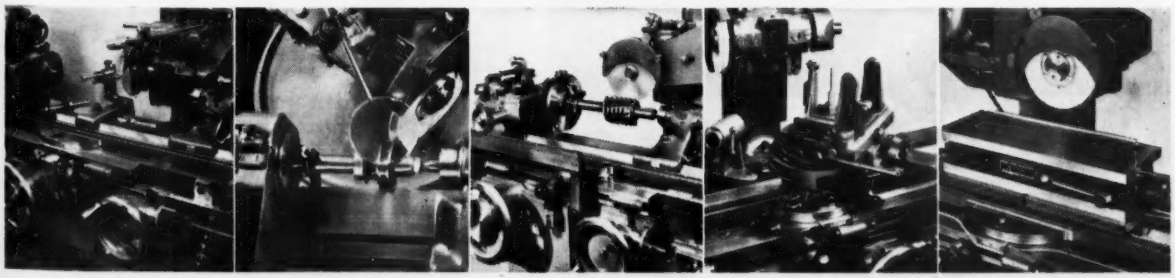


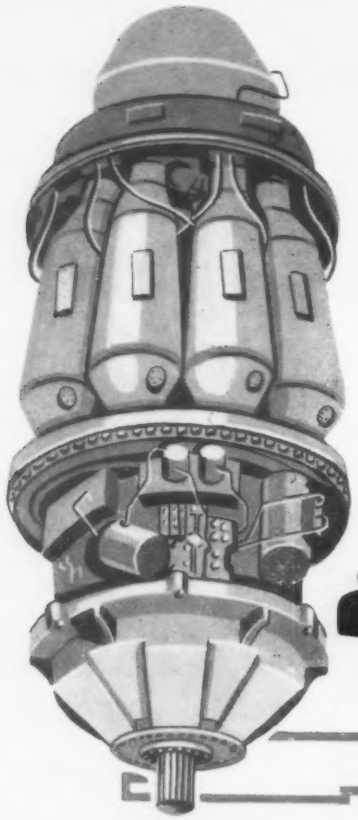
Circular Form tool grinding equipment.

A typical form tool grinding job.

Hob Grinding Attachment.

Radius Grinding Attachment

Magnetic Chuck mounted on Surface Grinding Attachment.



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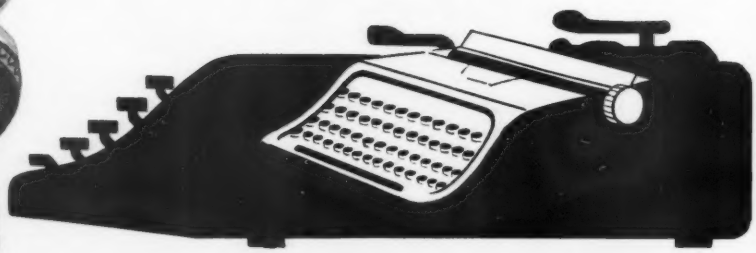

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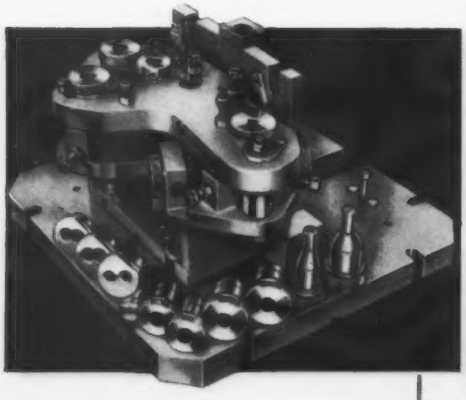

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Electrical Aids in Industry *Data Sheet* **No. 6**

Lighting-1

Good lighting affects productivity in three ways, (1) by directly increasing the speed of working and reducing errors and wastage, (2) by improving overall factory efficiency through better supervision and housekeeping, (3) by providing better working conditions, thus improving labour relations and avoiding frequent changes of workpeople.

It is not possible to judge by the eye alone whether the lighting in any factory is good enough to serve these purposes because the eye has a tremendous range of adaptation (vision of some kind is possible within an illumination range of 1,000,000 to 1) and is hence an unreliable measuring instrument. Severe mental and eye strain or unconscious slackening of working speed may occur under lighting which *appears* to be adequate.

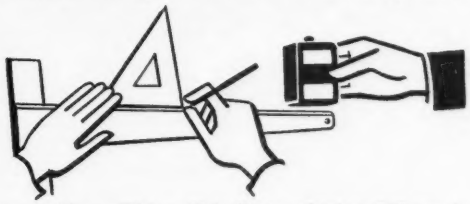
The only reliable way to appraise factory lighting is to conduct a lighting survey using a lightmeter, an inexpensive instrument which measures the actual illumination available. These figures can then be compared with official recommended values for the various tasks.

Lighting Survey

A methodically conducted lighting survey is the first step towards achieving good productive lighting. The average artificial illumination at working height should first be measured. This requires a number of readings at various positions relative to the lighting fittings, particularly beneath and between fittings and by the wall. The average of the readings should then be compared with the illumination values recommended by the Illuminating Engineering Society. The following is a general guide to illumination requirements.

NATURE OF WORK, PROCESS OR MATERIAL	ILLUMINATION LUMENS/SQ.FT.
Rough or routine work. Large detail. Medium to light material of good contrast.	7
As above, but work rather more skilled or critical.	10
Ordinary work usually involving workers' inspection. Medium detail and contrast.	15
Fairly critical work, fairly small detail or poor contrast.	20
Skilled work, small detail or dark material.	30
Fine or critical work, very small detail, very poor contrast or very dark material.	50
Very fine exacting work.	100
Minute work.	200

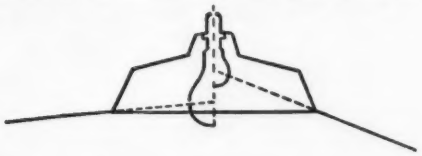
In addition, readings should be taken at selected working points with the lightmeter so placed that it measures the light on the work while the operative



is working. This will indicate whether full use is being made of the light or whether shadow is obscuring part of it.

Glare

Any direct light on the eye tends to reduce its sensitivity—thus reducing the power to see. Increasing the intensity of the light source may



therefore not improve matters unless care is taken to avoid glare either by correct positioning or by the use of correctly matched reflectors and lamps.

Walls and Ceilings

Certain surfaces and certain colours absorb light and therefore do not make the best of a light source; others reflect light and, so to speak, feed back on to the work a portion of the lighting which would otherwise be lost. Bright walls, moreover, have a good psychological effect which makes for contented —and therefore productive—operatives.

Shadows

Unnecessary shadows may seriously slow down work and also cause accidents. Lightmeter readings should always be taken under conditions exactly similar to those obtaining while work is going on. The operative himself may mask his work, an overhead crane or a heavily loaded conveyor belt may periodically obscure a light fitting, or a dust-laden atmosphere may reduce the designed lighting values.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2. Telephone : TEMple Bar 9434.

Excellent reference books are available on electricity and productivity (8/6 each or 9/- post free)—"Lighting in Industry" is an example.

E.D.A. also have available on free loan in the United Kingdom a series of films on the industrial uses of electricity including one on industrial lighting. Ask for a catalogue.

+Mills Bright Drawn Special Sections eliminate the need for machining from the solid, have a bright, smooth finish and are accurate in detail and to required limits. Produced in Mild and Medium Carbon Steels, Free-cutting and Case-hardening Steels, Heat Treated or Alloy Steels and in equivalent Mills "Ledloy" Steels.

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***BRIGHT* steel special sections**

Please write for our illustrated catalogue or send us drawings of your requirements.

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WOODLEY. NR. STOCKPORT

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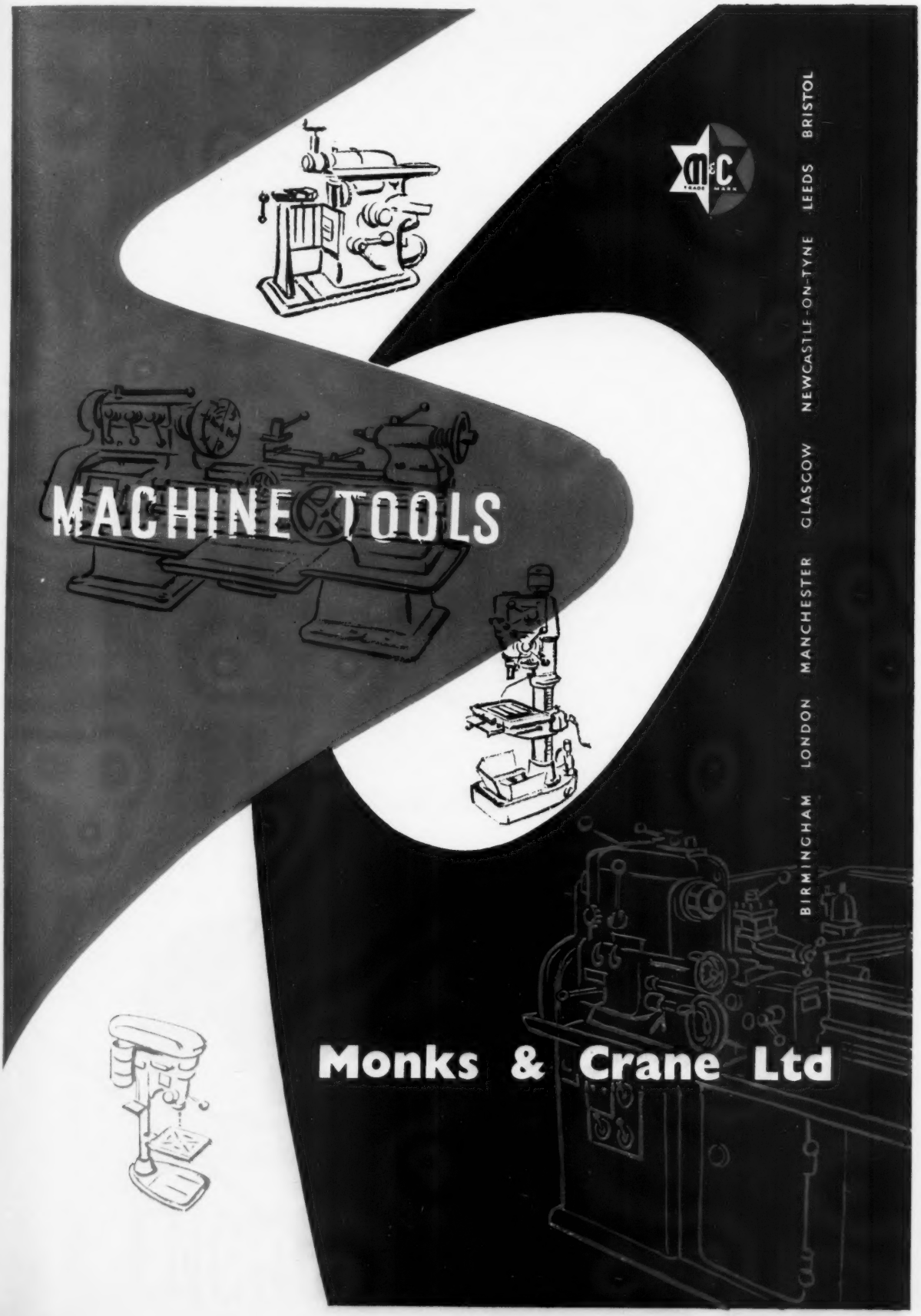
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now cast in MEEHANITE

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Whether you require one casting or thousands, we can meet your needs promptly, in sizes from a few pounds up to 20 tons in weight. Production methods include light, medium and heavy machine moulding; also floor, loam and shell moulding. A skilled patternmaking service is at your disposal. Your machining and fitting requirements can be undertaken by our fully modernised machine shops.

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ENGINEERING DIVISION · THORNCLIFFE · SHEFFIELD

ENGINEERS OF PROGRESS

If you want to know something about
BORING & TURNING MILLS...

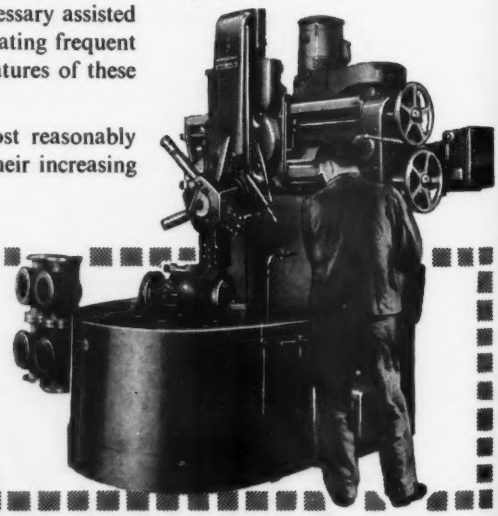
SEE YOUR COMPETITORS!

If your business requires the boring and turning of medium to large castings and forgings or similar components, and you do not use Webster and Bennett Boring Mills, it's highly probable your competitors do.

In that case, they'll be getting the benefit of lower overheads, because on the bases of capital costs and running costs there are no other machines quite as economical.

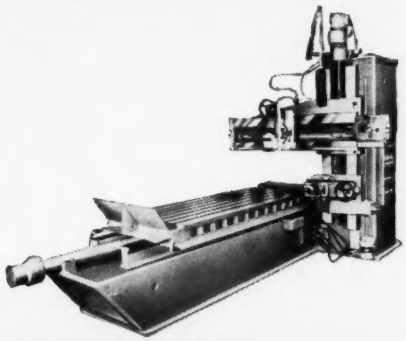
Powered for carbide tooling and high metal removal rates; centralised hydraulic controls for operating convenience; easy reservicing when necessary assisted by unit construction; self-compensating clutches obviating frequent adjustment for wear, are some of the outstanding features of these machines.

Add to this the fact that they are probably the most reasonably priced machines of their kind, and the reasons for their increasing demand become clear.

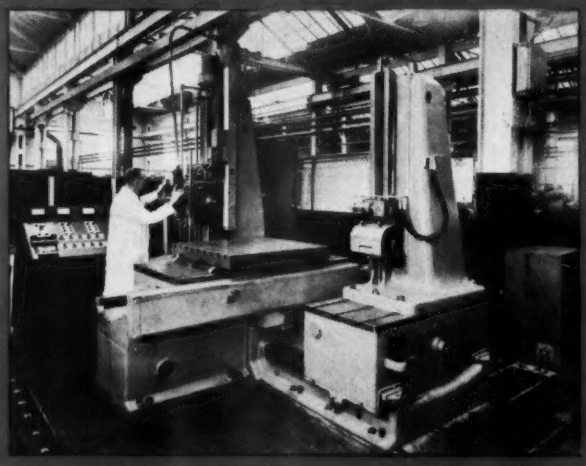


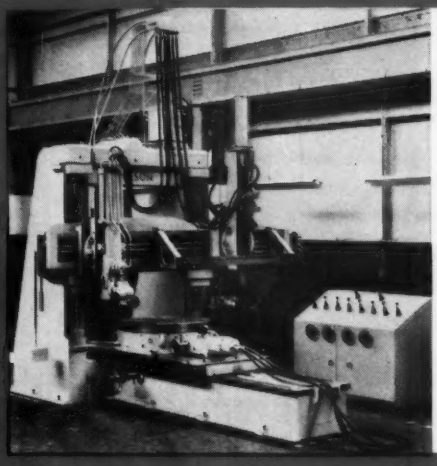
The illustration shows one of the battery of Webster and Bennett Boring Mills installed in the London Works of Dewrance & Co. Ltd., facing, turning, boring and screwing 5" valve bodies in a floor to floor time of 66 minutes.

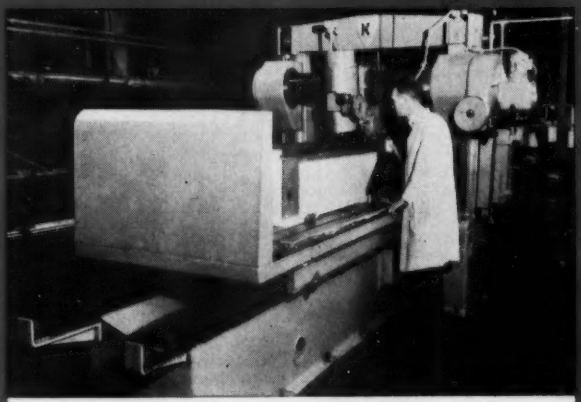
WEBSTER & BENNETT LTD., COVENTRY, ENGLAND



Keelavite, manufacturers of the widest range of hydraulic power and control equipment are fully experienced in the design, manufacture, installation and maintenance of complete hydraulic systems for the machine tool industry.







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130°c
New triple life f
AT THIS DANGER MARK

fe for Shell Alvania

For years now Shell Alvania greases have been a byword for stability in roller bearings. What is the secret? Lithium 12 hydroxy stearate, one of Shell's prized patents.

But stability is not enough. As new industrial techniques have been developed and new machines evolved, new problems have emerged with them and old problems have been intensified. Shell research teams at Thornton have made it their business to find the answers.

First problem was the *length of life of the grease charge* at the higher running temperatures of some modern machines. Could this life be lengthened? Shell scientists, through new Shell Alvania, have given an emphatic answer – at 130°C., the danger mark where most greases fail quickly through dynamic oxidation, Shell Alvania will live three times as long.

The second associated problem was the oxidation promoted by yellow metal cages. Could this be reduced? The answer, in Shell Alvania, is the virtual suppression of the effects of yellow metal.

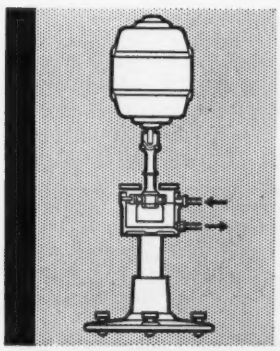
Problem three was corrosion caused by moisture. Could this be prevented? The answer was given in the Thornton Wet Bearing Rig Test*, where new Shell Alvania won an anti-corrosion rating of 10 out of 10.

New Shell Alvania greases were put on the market in March, 1957, and already, as proof of their success, tens of thousands of new electric motors leave British makers' works each week with Shell Alvania greases in their bearings.

What is the moral of the Shell Alvania Story? That Shell research is supremely applicational. The centre at Thornton is always ready to work with even the most specialised sectors of industry to produce the right grease for the job. If you and your organisation have any major lubrication problems, it will pay you to get in touch with your local distributor of Shell Industrial Lubricants.

The Research Story

* In the Thornton Wet Bearing Rig Test, water was fed through a 20 mm. bore bearing with a special demountable plastic cage (to simplify inspection) charged with the grease under examination to a weighed quantity rotating at 3,000 r.p.m. The rate of supply of water was one gallon per minute, the water running to waste. After 5 hours' operation the bearing was removed and stored horizontally half immersed in water for three days. Anti-corrosion merit ratings were given at the end of the test. High-quality greases without special protectives showed an average rating of 3 out of 10, while new Shell Alvania rated 10 out of 10.



SHELL

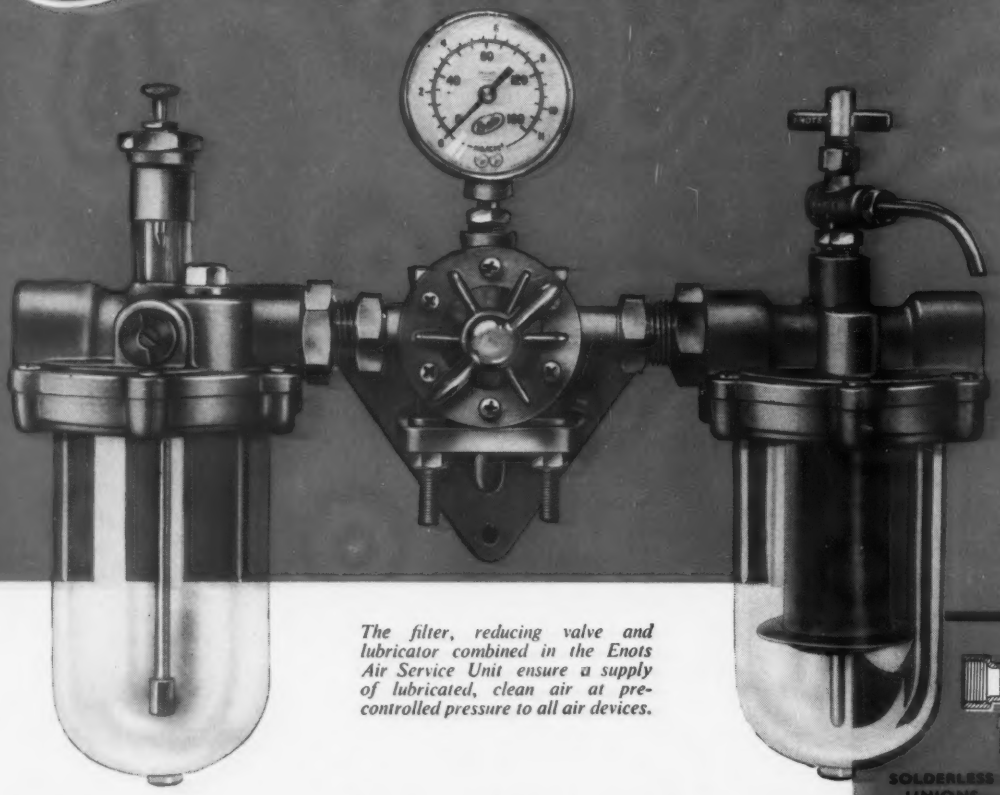
ALVANIA GREASES

another proof of Shell leadership in lubrication

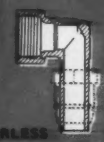
Enots

AIR SERVICE UNITS and PNEUMATIC EQUIPMENT

improve efficiency and reduce production costs



The filter, reducing valve and lubricator combined in the Enots Air Service Unit ensure a supply of lubricated, clean air at pre-controlled pressure to all air devices.



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BLOW HOSE NOZZLE VALVES

A pressure reducing valve fitted to almost any pneumatic device will save its cost in a very short time by reducing air consumption. At how many points in your works are you using full line pressures of up to 100 lb. per sq. inch where 80, 60 or even lower pressures would be adequate? Savings are more or less in direct proportion to pressure reduction.

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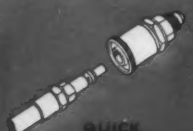

QUICK COUPLINGS

EJECTOR VALVES

LEAFLET AS357 describing our Air Service Units and individual components and other catalogues on Enots pneumatic devices are available on request.

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ON BALL & ROLLER INNER & OUTER RACES

to within ·0002" on parallel and ·0005" on width

at rates of up to 10,000 per hour!

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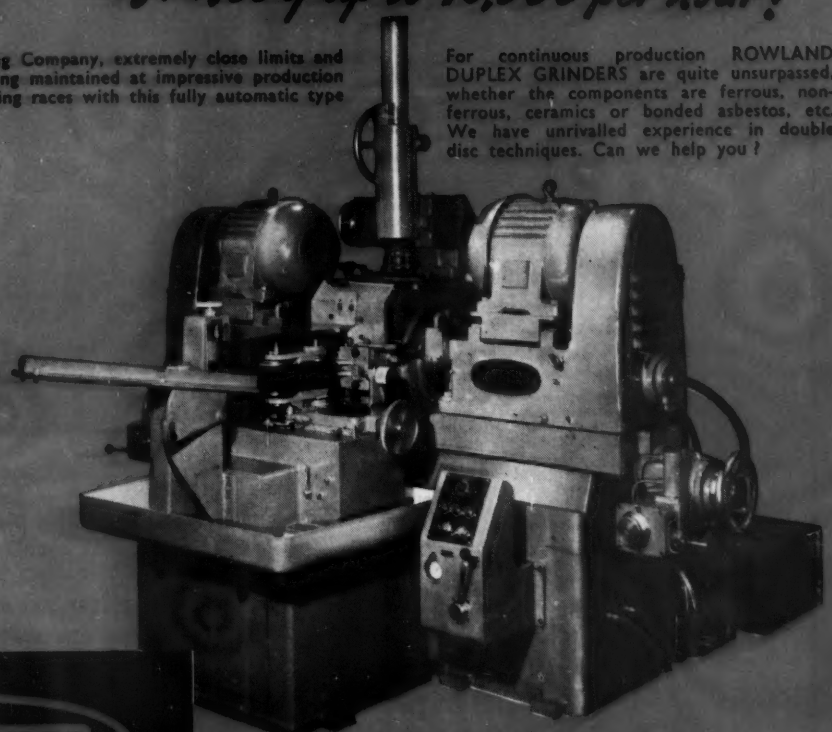

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DUPLEX GRINDERS

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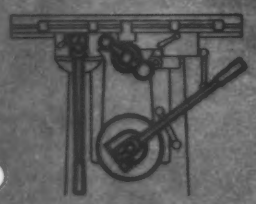
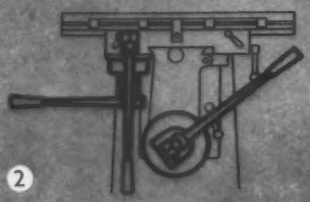
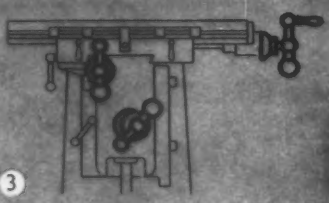


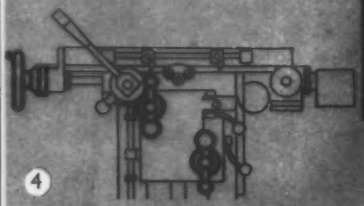
1 Hand Feed—lever, screw, lever.



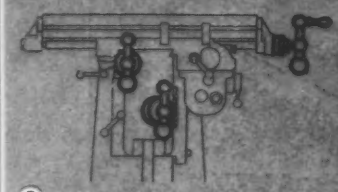
2 Hand Feed—lever, lever, lever.



3 Hand Feed—Screw, screw, screw.



4 Multiform—semi-automatic cycle.



5 Normal automatic feed.

6 × 4 = 24

TYPES OF FEED | SPEED RANGES | POSSIBLE COMBINATIONS

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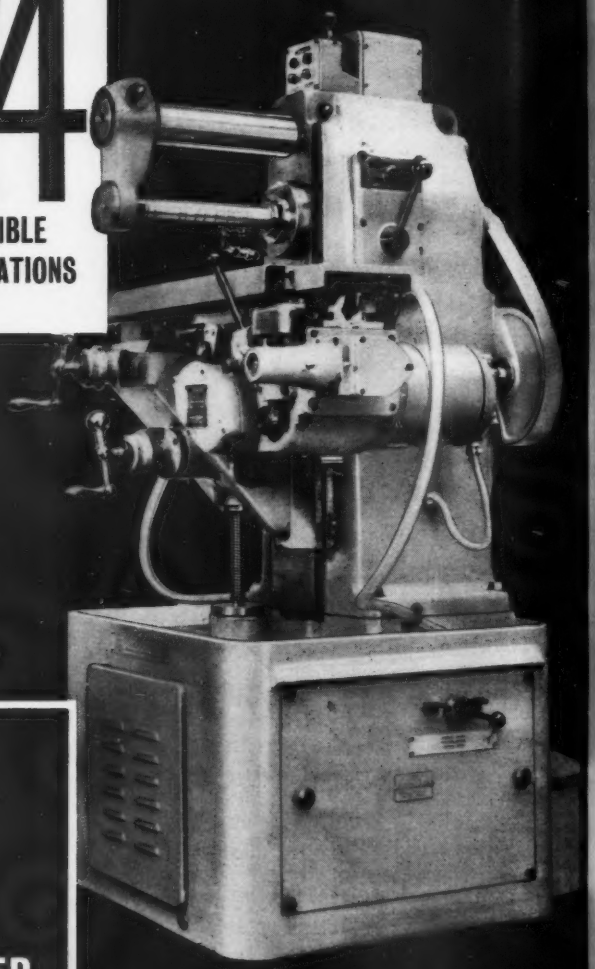
A&S MODEL 'I' HORIZONTAL MILLER



6 With automatic cycle.

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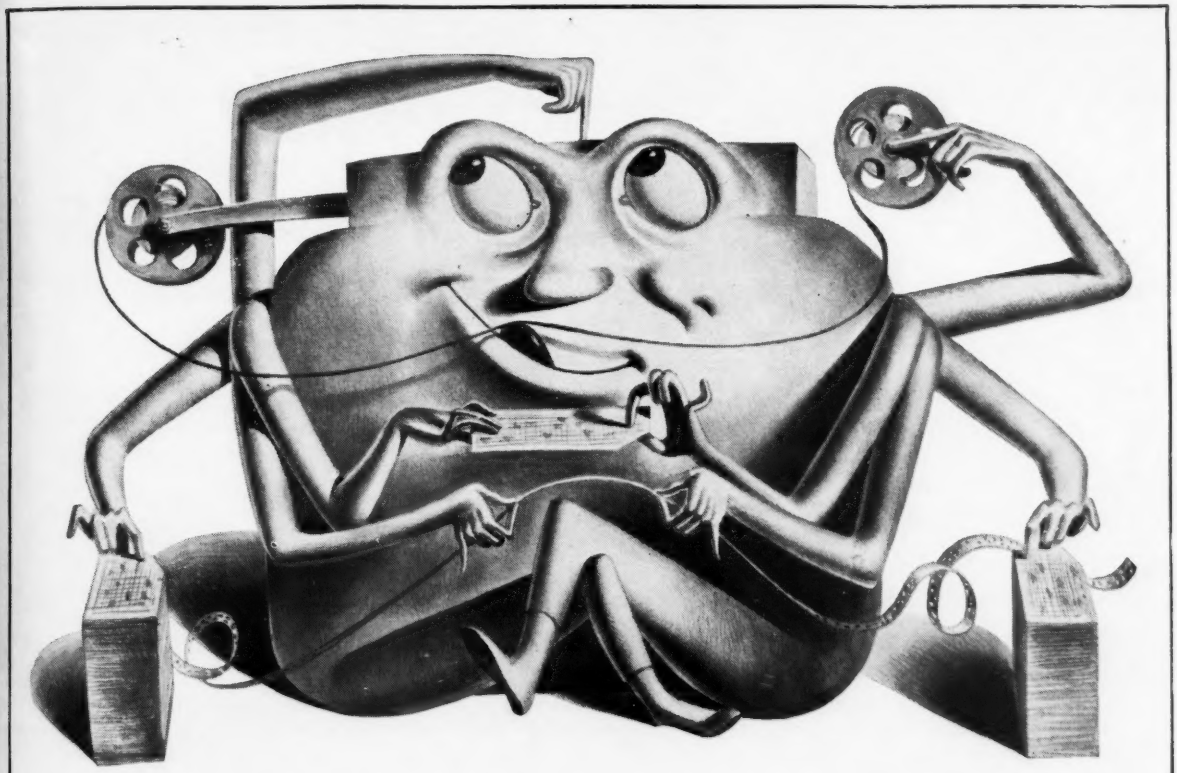

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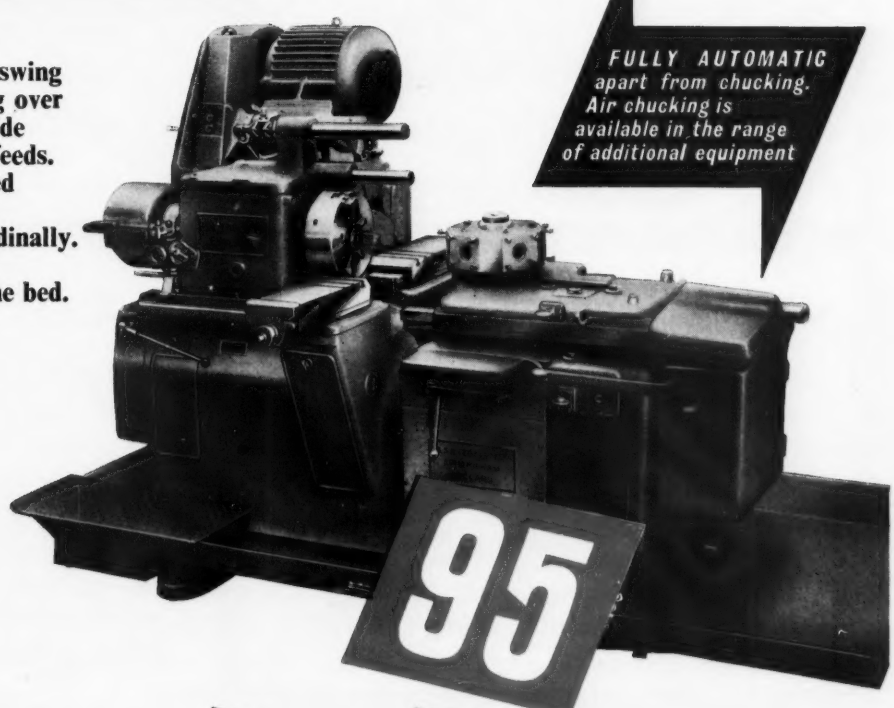
95 **Maximum swing 12½″. Swing over cross slides 10¾″. Wide range of speeds and feeds. Three automatic speed changes. Headstock adjustable 4¾″ longitudinally. *FIVE* face turret ; adjustable 2″ along the bed.**

FULLY AUTOMATIC apart from chucking. Air chucking is available in the range of additional equipment



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	5M ins	5M mm	95 ins	95 mm
Maximum swing	7¾	197	12½	317.5
Maximum swing over cross slides	6⅝	168	10¾	273
Cross slides stroke	2¾	70	4	101.6
Cutting travel of turret	4⅜	111	5¾	146
Number and range of spindle speeds	21 FORWARD 14 REVERSE 58 to 1458 r.p.m.		30 40 to 834 r.p.m. or 60 to 1220 r.p.m.	
Horse power of main motor	4½		10	

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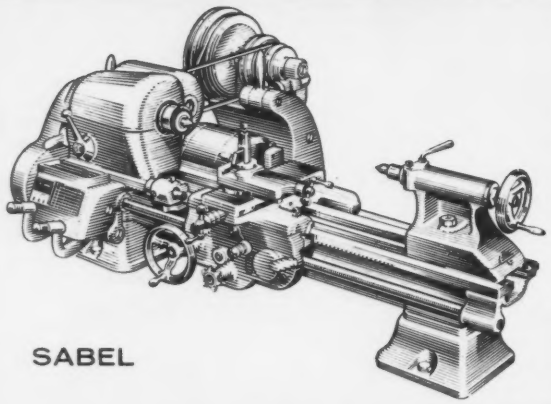

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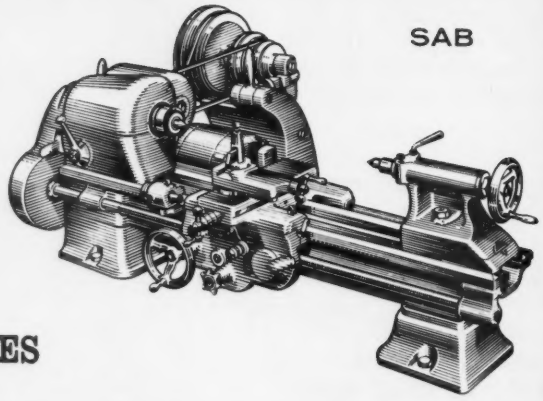

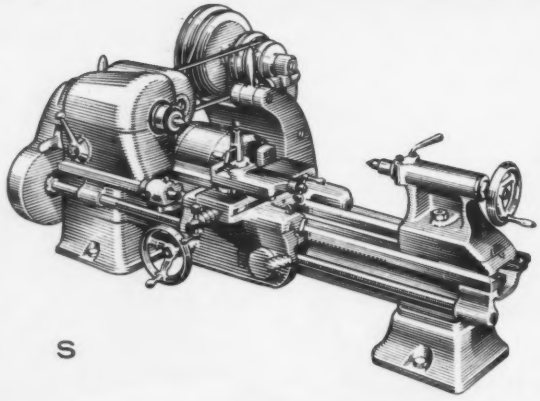

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with quick change gearbox
16 Spindle speeds from 45–1200 r.p.m.
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Tested at 2,500 p.s.i.

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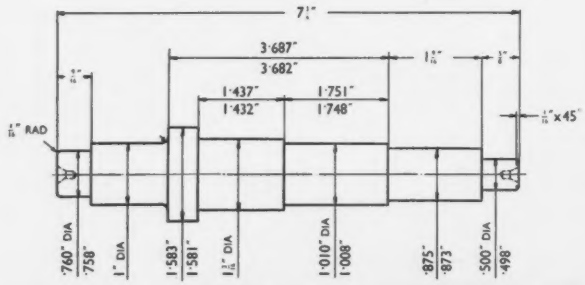

EXAMPLE SHOWN WAS BEING PRODUCED IN BATCHES OF FIVE FROM 1¾" DIA, 65 TONS PER SQ. INS. HEAT TREATED NICKEL CHROME MOLYBDENUM STEEL, ON A STANDARD CENTRE LATHE IN A FLOOR TO FLOOR TIME OF 30 MINS. EACH

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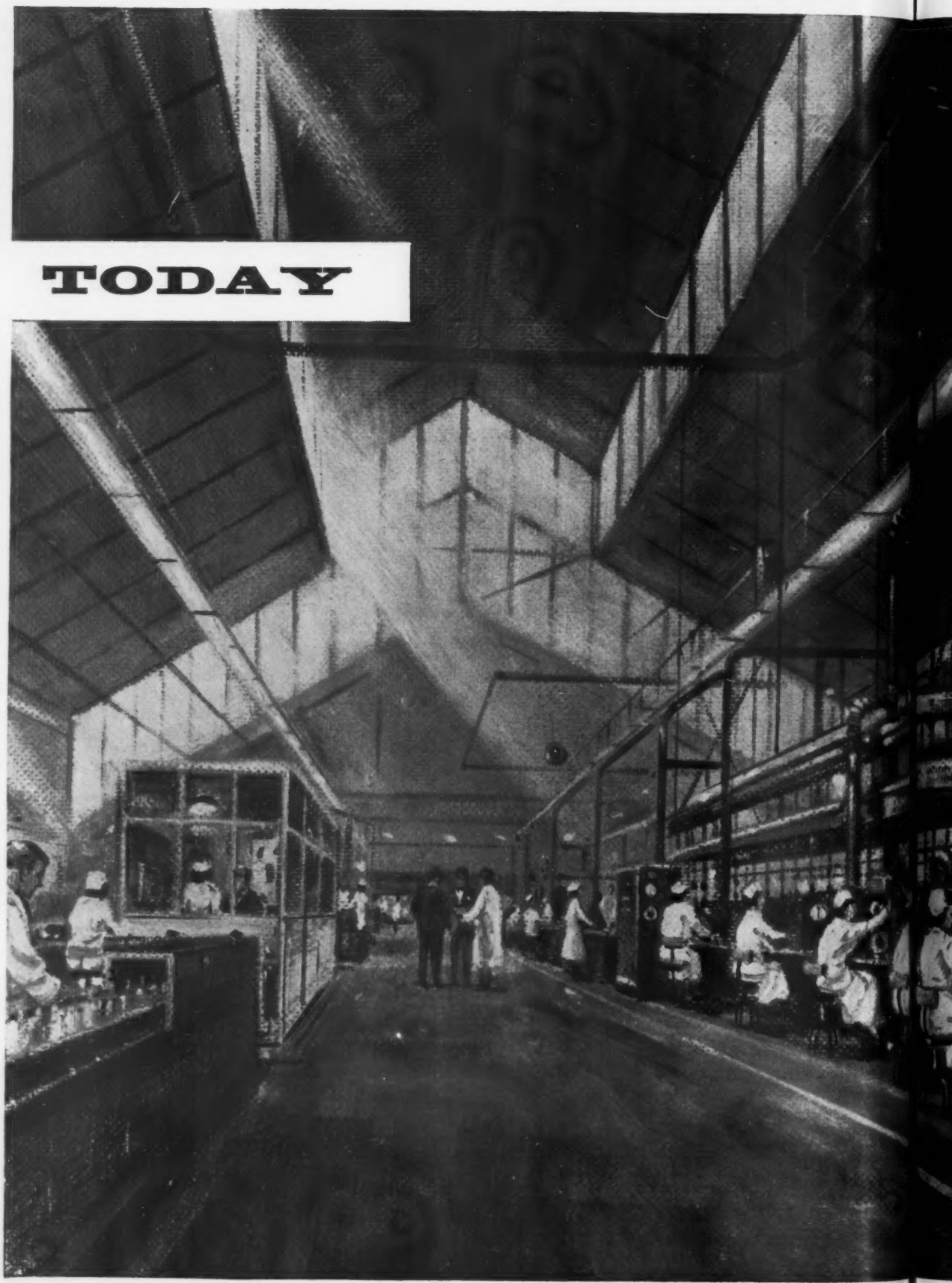
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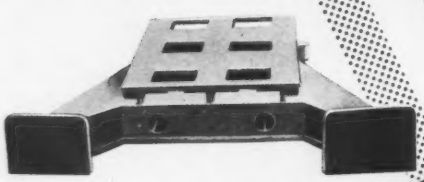

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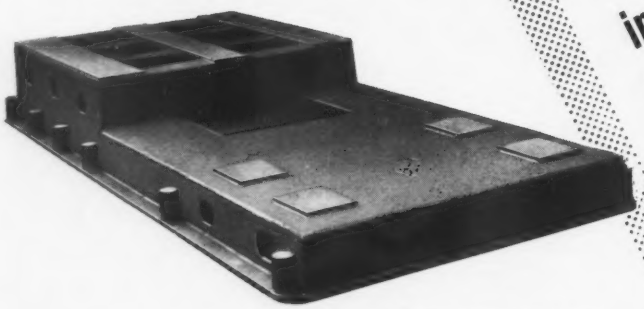

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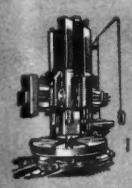
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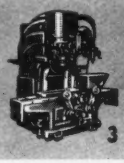
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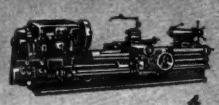
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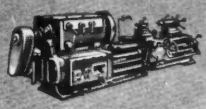
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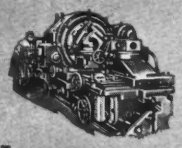
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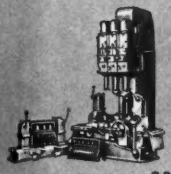
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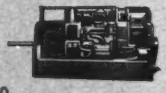
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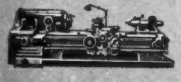
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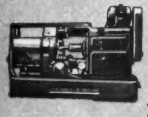
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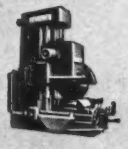
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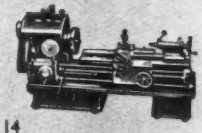
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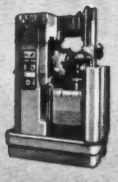
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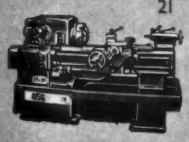
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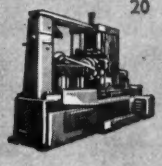
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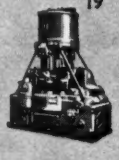
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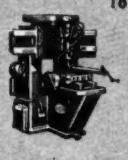
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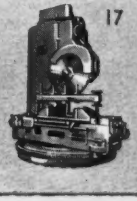
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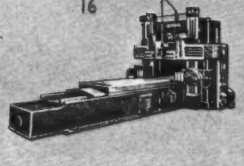
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The Institution of Production Engineers Journal
VOL. 38 NO. 9 SEPTEMBER, 1959

INDUSTRIAL RELATIONS AND THE PRODUCTION ENGINEER

by EDWIN FLETCHER, M.A.

Secretary, Production Department,

Trades Union Congress

A Paper presented to the

South Eastern Region

of The Institution of Production Engineers,

23rd April, 1959

I HOPE in this Paper to put forward a trade union point of view, speaking as the head of the Trades Union Congress Production Department. I am very grateful for the opportunity of taking part in this discussion with production engineers, because we are asked to consider an important subject for the health of industry, of interest to The Institution of Production Engineers as well as the T.U.C. I expect to receive here a sympathetic hearing inasmuch as I am asking for almost an engineering approach to industrial relations.

You engineers like to think in terms of objectives, attainable objectives; and I imagine that you are, just as I am, sick of the post-War trend towards generalisations about inflation, full employment, and so on. They do not help us to get to grips with the real problems.

I am not suggesting that it is easy to have attainable objectives — and the further you get away from the man and the machine, the more difficult it is to reach them.

The existence of a target when dealing with human beings helps towards the achievement of the

objective. We human beings are complicated. We want to know what we are supposed to do and how near we are to achieving it.

There is an over-simplified illustration of this in connection with some work done at Cambridge by the Medical Research Council Applied Psychology Unit. The job was a camera, an "In" tray and an "Out" tray; and the task of the operative was to take photograph after photograph — a very repetitive job. The workpeople were paid time rates, and the experiment was designed to assess the various methods of doing the job. One of the changes was to put a counter on the camera so that the operative could see how many exposures he had made in a given period, and the mere fact of putting that counter on the machine — one variation out of many — produced an increase of 25% in output. Five days' work was done in four days by having a specific objective. Presumably when a man gets to a figure of 465, he thinks in terms of 500 and gives himself a target. I am, of course, opposed to sweating, but that does not seem to me to be sweating! It seems that the operator gets more satisfaction out of a job if he hits the target. In this there is an elementary truth which is missing from a great deal of industrial organisation.

satisfaction not a by-product

To turn now to the *background* pattern of industry, there are three lines of responsibility. There is the production-productivity factor, which all production engineers know — even though it may mean an industry contracting, as the cotton industry has had to contract. The second line of responsibility concerns looking after the consumer, and we seem only to be able to do that if we have a Monopolies Commission and a Consumers' Research Organisation to see that what is on the label is in the packet. The third line of responsibility concerns the satisfaction of the people at their work, and in most discussions on industrial development and responsibility in industry that aspect of it rarely comes in.

You must expect me to be more insistent on that third matter than management because I represent operatives, and it is the employees' satisfaction we are talking about — although it also includes administrative workers, clerical, and production engineers! The provision of this satisfaction is a basic responsibility of management. The satisfaction may be partly financial, but partly it is social. A man spends the greater part of his waking life at work and society has the duty to see that he gets satisfaction. We cannot support this derelict idea that a man buys his life by going to work for eight hours plus, with one hour for travelling. Somehow the operative must get satisfaction — partly from group relationships and partly from his craft. Can we expect democratic society to be effective and to take conscious, level-headed decisions, unless its citizens obtain a reasonable degree of satisfaction from work ?

There is nothing really new in this approach to industry. Wolf, one of the disciples of Taylor in the United States, said that no matter how carefully a work study man produces the best method of doing a job, it ceases to be the best method as soon as the operative does not want to do it that way. That is true, but the operative may not want to do it that way for a variety of reasons. As production engineers, would you please give consideration to how that aspect of job planning is brought into your responsibilities ? Can you leave the question of satisfaction as a casual by-product ? You know perfectly well that in the greater part of British industry it has been a by-product for many years.

I want now to go off at a tangent and to make a quick check on how industry is doing. I do so for this reason. I am talking about industrial relations and responsibilities. There are certain background aspects and one is the success which comes from a group or a society which is expanding and which can therefore give a feeling of dynamic participation.

international comparisons

There are no absolute values, but the United Kingdom used to be at the top of the international league table of industrial productivity and general standard of life. Where is it now ? We have been passed by the United States, Canada, Australia, New Zealand, South Africa, Switzerland, Sweden — I am not sure where you draw the line. The tendency has been for us to go down the scale for some very good reasons and, I think, for some unnecessary reasons. However, let us have a look at the rate of progress, because it is that which gives the feeling of getting somewhere which helps good industrial relations.

In each of the past three years, Russia has expanded her production by about 10%. Until recently the more flexible French economy was increasing industrial production by 10%. If we in the United Kingdom could increase our industrial production or productivity by anything near 10%, there would be few of these problems of industrial relations and wages. Even a regular 7% increase is big enough to take care of wage demands as well as capital development, etc. I know that France increased productivity in the context of inflation, and our challenge is how fast can we develop without inflation. We ought to be able to get much nearer to 10% than we do.

If you take the proportion of national income that we have lost through being on this wretched production plateau for three years, when we might have increased manufacturing output by 7%, it is one-fifth of the manufacturing output of the country; and that is not chicken feed! The responsibility of production engineers therefore is wider than the immediate job within their four walls!

inter-firm comparisons

I want now to refer to the main standards which we in the trade union movement have for assessing the people who are in charge of us. Since there are no absolute standards, we have to look for comparisons. Therefore, we have been interested in the published material on the difference between efficient and inefficient firms in many industries. There is a wide margin of efficiency which is a drag on good industrial relations. Of course, in some cases the difference is justifiable. For example, in the coal

industry if one compares an out-of-date pit with a modern one, of course the costs of production of the former are higher. Again, if the new South Wales steel mills are compared with the old hand mills further along the coast, of course the costs of production of the latter are higher. But I am talking about differences within production engineering competence. This is an I.Prod.E. meeting, so I will mention a Paper published in the March, 1954, Journal of The Institution of Production Engineers, and written by Mr. Frank Nixon, of Rolls-Royce Ltd. He took 12 components bought in by Rolls-Royce from sub-contractors and analysed the cost of production of the firms concerned. He charted them — with the lowest price at 100%, there were two at 240% and many at 200%. This is what Frank Nixon said: "Amongst these differences were found in one case a material utilisation of 41%, as compared with 55% in the best case, and accounting for £4 in the cost of a £20 component; in another, a rejection rate double that of the best case, due to the unexpected effect of an 'economy' measure; in another, an excessive amount of corrective work . . ." These are factors within the competence of management of which trades unions are aware, and which they are anxious to play some part in removing.

Workpeople would get satisfaction if they were given an opportunity to participate. But I must not generalise too much. I acknowledge the existence of many fine industrial firms in this country, and I am reminding you of the difference between firms which we all know exists. Moreover, I would express from the trade union angle some gratitude that the British Institute of Management is tackling this seriously and is jointly developing an Inter-Firm Comparison Centre with the British Productivity Council.

Trades unions have no right to *all* information, but I hope management will realise the additional strength to be obtained by discussing development operations with the trades unions and the workshop representatives. They may say: "Why should we discuss this with the trades unions at all? It is the substance of management". Of course it is, but I believe — and I will argue it in detail later — that the solutions to many of our problems are coming from the joint approach to these problems.

the trade union contribution

What could one expect from the trade union side? This is where it is difficult to be certain that we are speaking the same language. Let me ask a question. Almost at the same period as the Briggs Body Company's dispute, the unions concerned in the cotton textile trade gave £10,000 to the Cotton Board to help in the development of the industry. How many people were aware of this trade union action? Moreover, how can management or any people dealing with trades unions know the right action to take unless they are aware of the action which the trades unions have taken for the common objective of increasing efficiency and the development of industry? May that sort of knowledge not make a difference to one's attitude towards a trade union in matters of industrial development?

We all know of research associations, such as the Motor Industry Research Association. There are 40-odd research associations financed by subscriptions from firms in the industry and in receipt of a Government subsidy through D.S.I.R. because they are doing research — some basic, some applied and some operational. There are now trades unionists on the main committees of 19 of the 40 associations, and in half-a-dozen cases the unions give money every year to the research associations. The largest amount, I believe, is 600 guineas a year; it should be regarded as a sign of participation rather than for the intrinsic value of the money. How many of you present at this meeting were aware of regular donations to research associations by trades unions? Remember, trades unions respond to conditions which management can help to create. There is a tendency every year for more and more unions to be associated with their research associations, and for the financial relationship to become more natural. I believe this to be a very good development.

But is it what *you* want?

the heart of industrial relations

This is the heart of industrial relations. But we don't study industrial relations very seriously in this country, in contrast to many other countries where there are numerous Chairs of Industrial Relations in universities.

It is worth industry paying more attention to these developments; because although we in trades unions accept some responsibility for your ignorance — because we pay far too little attention to our public relations function — it is not for us to do management's job, or to be its communications channel. Nor can management pass all the responsibility to personnel departments.

Last Christmas I was given a book written by a Hungarian. It was called "How to be a Alien", and there was a statement in that book to the effect that the English do not like sex — they have hot water bottles! It is an appropriate twist to say that British industry does not like industrial relations — they have personnel officers!

It is elementary logic that trade union standards and conditions depend on the health of industry; and every union which is doing its full job is concerned about the pace of development in industry. There are plenty of positive actions in support of this case — not only the £10,000 to the Cotton Board or regular subscriptions to research associations! The Anglo-American Council of Productivity was more or less conceived in the T.U.C. offices; the T.U.C. subscribes each year to the British Productivity Council the same amount as the F.B.I. Much practical training is carried out and sponsored by the T.U.C. with a large number of complementary courses, the apex being work study, etc., training with industrial consultants. We have now had 60 regional officers of unions so trained by industrial consultants for periods up to four months. This natural positive development is not sufficiently understood by many people in industry.

A trade union is only the getting together of workpeople for protection and advancement. In the United Kingdom we have a peculiar structure: to some extent an historical accident. We have 180 unions affiliated to the T.U.C., varying from one with a membership of $1\frac{1}{4}$ million to one with less than 100. They are of different types — craft, general, occupational, industrial. Their rule books also justify study. The study of unions is the study of social history. The positive strand is becoming more significant.

This is not a question of goody-goody trade unionism. The T.U.C. Production Department does not encourage people to be "good". It co-operates with unions to exert pressure towards increasing the pace of industrial development, and keeping the development pressures under control.

There must not be resentment because periodically we come up for wage increases. This is our responsibility to society — that we extract from reluctant employers — as well as to our members. There is nothing wrong in "extracting". Indeed, our society demands that we "use our elbows".

We do this collectively. We are a group society. If people are interested in fishing they join angling clubs, maybe to prevent water pollution. They may join the British Legion, a chess club, a church, with others with similar interests, and most workpeople join a trade union.

The fact that trades unions have to be militant on the question of wages and have to exert pressure must not lead you to feel that they cannot at the same time co-operate in industrial development. This may be difficult for you if you feel that certain wage claims are unreasonable, but remember we are a getting-together of workers for their protection and advancement. We do not work so much on principles as respond to conditions. Before the War there was mass unemployment, now there is full employment. Here are different conditions leading to a different response. In the engineering industry there are firms making the same end product and with the same unions as other firms, yet some are consistently strike-prone while others are strike-free. What are the reasons? They should be identified and considered in detail. Trades unions are always to some extent responding to conditions which you have made. Our approach is pragmatic.

the work study example

Take work study as an example. In the T.U.C. Training College we have an appreciation course in work study, widely defined. But we cannot "sell" work study!

A trade unionist in a factory in which work study is being introduced responds not just to work study. He will respond to the whole set of conditions in that works. If the management has earned our trust, we are more likely to accept work study than if we distrust its motives. You cannot isolate work study from the rest of the workshop conditions. Unless I know the existing workshop conditions, therefore, I cannot anticipate precisely how a trade union *should* react.

Work study may be something precise to you, but it is not to us. It is a phrase. We had an example recently where a small union asked for the advice of the T.U.C. Production Department on a work study matter which was being introduced by a consultant. After examination, we found that the firm had no interest in improved methods: it was using consultants merely to cut wage rates! There was no real interest in work study.

a critical analysis

From our point of view work study is a critical analysis of how a job is being done with a view to improving it. There are scores of cases on our records where work study has been introduced and has increased productivity and wages, and has lightened the burden; yet it is the precise set of conditions created by the management in each case to which the response will be.

There is also the important point of over-concentration on the man on the machine. Direct labour is becoming a smaller proportion of total costs, but there still seems to be concentration on the operative in work study investigations offices to the neglect of the rest of the organisation where a greater part of the costs emerges.

I have indicated that our response is bound to be to the situation as we find it, and it is no wonder that the individual trade union's attitude towards work study varies. The Agricultural Workers Trade Union has campaigned for it. It has been more forthcoming than the National Farmers Union! The Textile Unions and the National Union of Boot and Shoe Operatives have agreements on how work study shall be introduced. Other unions are acquiescent only and some distrustful.

Good industrial relations is a key part of the introduction of work study. Also important is care and attention by management to detail. There is the selection of work study engineers: remember, work study is not everybody's cup of tea. Inadequate training is the reason why many people are stopwatch-bashing under the guise of work study. These people are doing a great deal of damage to our generally constructive approach. Moreover, work study is sometimes over-sold to us as something which provides all the answers, and only a few such instances can create a dangerous climate. There is nothing easier to make look ridiculous than over-sold work study.

Work study practice provides neat little formulae for fatigue allowances. And we accept them as rough justice. But what does anybody here know about the measurement of physical fatigue? Precious little, but we do know that it can vary by several hundred per cent. between the ages of 21 and 61. We do not know anything about mental fatigue. Not knowing much about it, we hide behind stories like the old classic concerning the wheelbarrows which everybody was pushing except one bloke who was pulling his. The foreman said there must be a reason so the work study people must find it. Very belatedly they asked the individual: "Why do you pull the barrow instead of pushing it?"; and the answer came: "Because I hate the sight of the ruddy thing!" Why not?

Napoleon's theory that the moral is to the physical as three is to one is much more significant than the work study phrase: "one man and his job". As John Donne put it, "No man is an island unto himself" — we must see that our work study enthusiasts never lose sight of this.

participation: the present need

I have used work study as an example of how management can organise positive enthusiasm or precisely the reverse. It is the same with mechanisation. We can campaign for it or go on strike against it. Yet on advanced mechanisation the future of the country depends.

With increasing mechanisation the industrial relations pattern ought to be based less and less on one man and his job, and more and more on sustained intelligent co-operation from a team. You cannot measure with automation the extra work a man does. Indeed, usually you do not want extra output. You want sustained output. You want team work and individual piece-work looks silly.

At the Volkswagen plant there is no *individual* incentive scheme. There is job valuation with eight grades, the highest being the manager of the shop, the next the foreman. Additionally there is a group incentive scheme for each workshop — good straightforward organisation. That Company produces the ugliest car which has ever been seen, yet it has the longest waiting list of would-be purchasers! This is due to effective organisation of production, the proper use of work study, and less automation than in many other car manufacturing firms!

We are now surely coming to the conclusion that the object of industrial relations as a management subject has to be a co-operative productive relationship, in which the constructive forces of the trade union movement are not only recognised, but used, by management. Many of you will have read "Looking at Industrial Relations", one of the silliest booklets I have ever seen. I ask you to read it again and judge how far it conforms to what is required in the present industrial situation.

We are being strangled by outworn tribal customs, particularly in the engineering group of industries, which I have been brought up to regard as the most bloody-minded employers in the country. It may be the employers regard our engineering union as being most truculent! Should we not analyse the tribal customs which cause this unfortunate relationship? It is perhaps partly due to the fact that in many — not all by any means—of the firms in the engineering group of industries, the skilled engineer is still hired and fired as casually as the raw material used. With automation or a high degree of mechanisation, this can create an explosive situation.

Again, to what extent has the engineering industry invited unions to sit round a table and discuss where the industry is going? I don't mean during or associated with wage negotiations; then it is all special pleading. Conditions have to be created whereby matters of industrial progress can be discussed logically and calmly in the interest of trades unions and employers, both of whom are interested in the speedy development of their industries. I said earlier that in 50% of the research associations, the unions had participated. There is only one in the engineering group with trade union participation! We have a great deal of leeway in the engineering group of industries to make good before we can have the right sort of industrial relations.

Production engineers should be sympathetic to what I regard as the "engineering" approach; that is, having the objective of increasing productivity quite precisely defined, creating our blueprint of approach and measuring the extent to which the result deviates from this objective.

"CURRENT PRACTICE IN FUEL EFFICIENCY"

6th Annual Refresher Course for Works and Plant Engineers

The above Course, arranged by The National Industrial Fuel Efficiency Service, will be held at the Clarendon Laboratory, Oxford, from 21st - 25th September, 1959.

Full particulars of the programme and other arrangements may be obtained on application to the Secretary for the Course, Mr. E. S. Watkin, at Ailsa House, 181 King's Road, Reading. (Telephone: Reading 50831 - 3.)

MAGNESIUM IN AIRCRAFT TOOLING

by KARL F. MELDE,

Pilotless Aircraft Division,

Boeing Airplane Company.

IN any new or relatively new field, there is no point to be gained by minimising the difficulties or problems that may be encountered. It is better to bring attention to these problems, show how they can be overcome, and then bring in the advantage to be gained.

Salesmanship is necessary; you might have the best idea yet, but if you are unable to convince others of the value of your ideas, they are worthless.

a new product

The use of magnesium as a tooling material is new. Only in the last three or four years has magnesium tooling plate been used to any great extent. First introduced in 1954, use has more than doubled each year until well over 1,000,000 lb. was used during 1957. Most of the magnesium tooling plate is produced by The Dow Chemical Company, Magnesium Division, at their Madison, Illinios, plant. Methods of production will be detailed later. Large stocks of magnesium tooling plate, as well as extruded bar stock (rectangular and rounds, tubes and solids), channels, angles, and I-beams, are maintained by distributors throughout the country, making for easy procurement in the shortest possible time.

fire hazards, real and imagined

Many people, when magnesium is discussed, picture magnesium as used in fire-bombs, flash powder, etc. True, finely divided magnesium burns with an intense blue-white flame. But in a solid form, in sheets as thin as .020 in. to 0.30 in., heat is conducted away so rapidly from an applied flame that as soon as the flame is removed, the magnesium fire goes out. Even drill chips or lathe chips are difficult to ignite with a match. However, grinding dust is dangerous and must be collected carefully and disposed of properly, as finely powdered magnesium is a fire hazard.

An approved type of dust collector uses water spray to remove the dust from the air stream; this is illustrated in detail in "Machining Magnesium" by The Dow Chemical Company.

Magnesium fires are never fought with water or carbon tetrachloride extinguishers, as they only add to the fire. Powdered graphite or any one of several prepared dry-powder extinguishers are used to fight magnesium fires by cutting off the supply of oxygen. An educational programme along the lines of: "What to do until the Fire Department gets there" is an advantage in preventing serious accidents from developing out of what otherwise would have been only a small fire. Leave the fire fighting to those trained in the proper techniques. Small fires will die out if isolated with a shovel and placed on a steel plate. A demonstration by qualified people will do a lot to remove many of the fears and prejudices against the use of magnesium.

new techniques required

Any new material requires new techniques in working and this always brings opposition from those who are reluctant to depart from established procedures and try anything new or unfamiliar. We all know the type: "If it isn't heavy and made of steel, it's no good." There are some tools that require weight and strength of steel, but investigation will show that many tools, formerly heavily built of steel, can be built better of magnesium. This will be covered later in more detail.

Magnesium can be welded by the shielded arc process to produce welds 90% - 95% efficient. Good penetration was obtained (Fig. 1), without preheating, welding $\frac{1}{2}$ in. plate to $1\frac{1}{2}$ in. Type A231B-T2 using 220 amps at 24 volts, $\frac{1}{16}$ in. wire at 550 ft. per minute, approximately 40 in. per minute travel of

This Paper was presented at the 26th Annual Meeting of The American Society of Tool Engineers, and is reproduced here by kind permission of the Society.

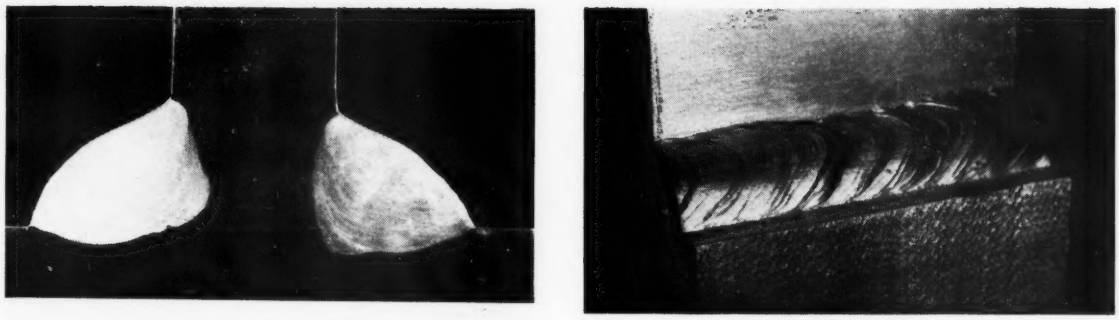

Fig. 1. Weld penetration of magnesium tooling plate — etched test specimen 4X.

torch using argon at 30 cu. ft. per hour. Reverse polarity (electrode positive) was used. Welders unfamiliar with welding magnesium have a tendency to use too low a range, which requires preheating. With experience and confidence, welders find it easy to produce sound, neat welds. To produce concave fillet, preheating, with lower amperage, is used. This would find a use where eye appeal of the finished part is required.

The easy removal of metal when using magnesium opens the way for radical departure from existing methods of metal working. Sawing, routing, grinding, etc., can be done with woodworking tools much faster and with less expensive equipment. Sawing can be done at wood-cutting speeds, using a metal-cutting, coarse-tooth blade. Contouring done with wood-routing equipment is faster (cutting speeds up to 9,000 ft. per minute), and can produce form dies, etc., without waiting for machine shop availability. Cutters should have large chip space, with one-half to one-third as many teeth as used for steel. High-speed steel works satisfactorily on magnesium, but cemented tungsten carbide is more suitable for the high cutting speeds possible.

Milling, drilling and tapping are operations where the special properties of magnesium can be utilised to cut machining time and cost. The roughing cut, when milling, should be heavy to minimise heating. The fine finish cut should be done at maximum speed. Mirror-like finishes can be obtained on milled magnesium surfaces.

Drilling falls into three categories — sheet metal, shallow and deep hole — and requires a special drill for each to obtain the best results. For sheet metal, a drill with a point angle of 60°, and the ends of the cutting edge rounded, produces a smooth finish and reduces burrs. Shallow holes require few precautions beyond keeping the drill sharp to prevent heating. Deep drilling can be done with speed and precision if a few variations from standard drills are used. High-helix drills with polished flutes, using a 60° spur point and a point angle of 118°, can be used for holes up to 25 times the diameter without requiring withdrawal for chip removal.

Reamers and taps used on magnesium should have fewer flutes than normal. Margin on reamers and flutes on taps should be narrower than normal to minimise springing of the metal.

Grinding of magnesium is usually limited to rough grinding, as the fine finish produced by machining needs no further refining. A coarse-grained, medium-hard wheel is used on magnesium. Proper dust collection equipment must be used. Magnesium is ordinarily ground dry to facilitate dust collection, which must be removed immediately with a wet-type system.

The details of welding processes are covered in "The Welding of Magnesium Alloys" by Paul Klain, Metallurgical Laboratories, The Dow Chemical Company, Midland, Michigan. The details of the machining processes are covered in "Machining Magnesium", Magnesium Division, The Dow Chemical Company, Madison, Illinois.

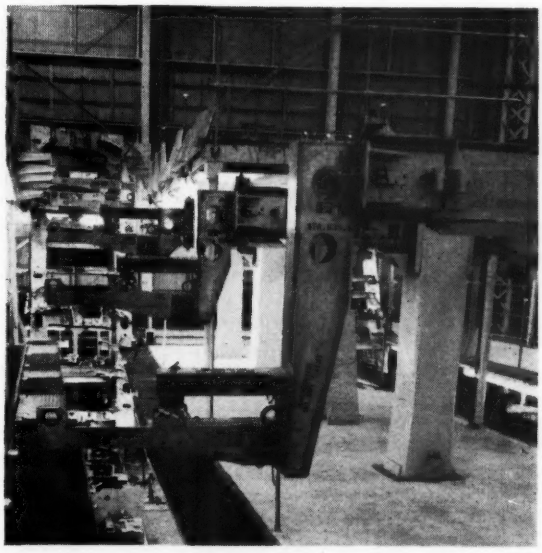

Fig. 2. Overhanging structure of magnesium tooling plate — 707 wing jig.

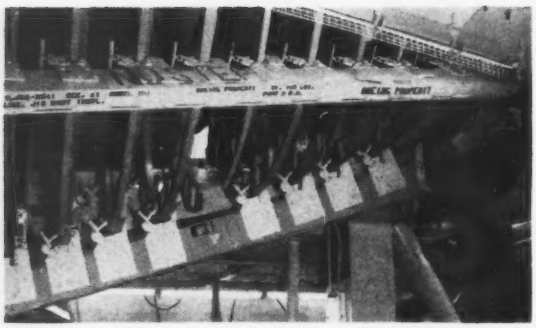

Fig. 3. Circumferential locators using magnesium channel — 707 body jig.

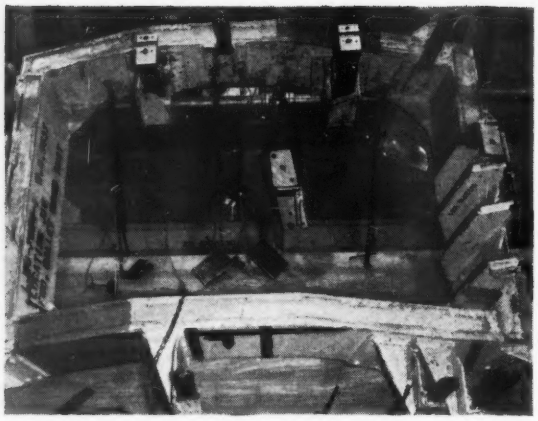

Fig. 4. Galley door locating jig magnesium tooling plate — 707 body jig.

uses of magnesium

Magnesium is finding wide use as a structural material for assembly jigs used in aircraft construction. Tooling plate, extruded channels and angles are forming an increasingly large part of the total material used. In areas such as balconies where the floor loading must be kept down, the basic structure made of magnesium provides a rigid frame with only one-half the weight of a comparably rigid steel frame. Overhanging jig parts (Fig. 2) welded from magnesium tooling plate, provide a rigid locator with an extreme reach without imposing undue loads on the basic structure, thus allowing a lighter and consequently less expensive supporting structure. This is used on a 707 wing jig at Boeing's Renton Plant. Locators that must be put in place and taken out by hand are much easier to handle and require fewer workmen when made of magnesium channel and tooling plate (Fig. 3). These 707 forward body circumferential locators have proved to be time and labour savers. What would otherwise be an awkward locator to handle with a crane or a sizeable working party, can be handled easily by two men.

The 707 forward galley door locating jig (Fig. 4) is another locating jig easily handled by two men. Its light weight makes it easily stowed when not in use. Again, its light weight does not require a heavy supporting structure in the body jig, all of which means a saving in steel. The stability of magnesium welded structures, properly stress-relieved, makes them invaluable in large aircraft assembly jigs.

As a base for sub-assembly jigs, magnesium tooling plate is finding wide use. With a shortage of machine availability in most aircraft tooling shops, the flat, stable surface of magnesium tooling plate as delivered is being extensively used as the base and reference plane on sub-assembly jigs for bulkhead sections (Fig. 5), ribs and longerons (Figs. 6 and 7); in fact, any applications where a flat surface is required. A large percentage of the sub-assembly tools on the 707 use this construction. These jigs can be handled by one man, facilitating storage and issue. As they are bench-type tools, ease of handling is of primary importance in cost reduction. Any provision that will eliminate the use of fork-lifts, overhead hoists or other weight-handling equipment is sought after. It has been shown that the use of magnesium in bench-type tools cuts not only first costs in fabrication, but secondary costs of handling.

The stability of tooling plate, either in the "as delivered" state or after welding and annealing,

Fig. 5. Bulkhead section sub-assembly jig using magnesium tooling plate for base.

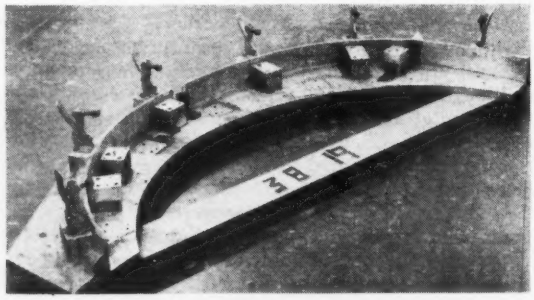

Fig. 6. Jet pod rib jig using magnesium tooling plate and channel — 707 power pack.

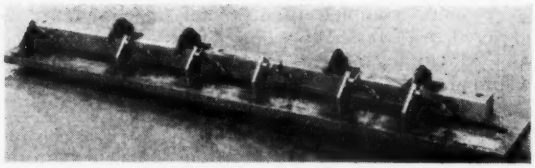

Fig. 7. Jet pod longeron jig using magnesium tooling plate — 707 power pack.

lends itself well to use in checking fixtures. The coefficient of expansion of magnesium is very close to that of aluminium. The rigidity obtainable without excessive weight again makes itself useful in cutting costs of handling and using. Using bars of equal weight, magnesium is 19 times more rigid than steel. A serious factor in any industrial organisation is the high percentage of back injuries due to weight lifting. The use of magnesium in movable tools can help to reduce this.

Form dies to be used in forming aluminium and its alloys have a high production rate, due to magnesium's wear resistance and non-galling properties. It is almost self-lubricating against aluminium and has helped to solve many difficult form-die problems. As it is so easily machined, the initial costs are reduced and the maintenance of the dies is at a minimum. Also, the low weight factor enters into the ease of moving dies by hand, again not requiring the use of weight-handling equipment.

The aircraft tooling industry has turned up many interesting and unusual uses for magnesium tooling plate.

The top for a master template table (Fig. 8) is made up of two thicknesses of 1½ in. plate, 4 ft. × 8 ft., with overlapping joints to a size of 20 ft. × 20 ft. The flatness of the 4 ft. × 8 ft. plates required no machining prior to assembly and resulted in a considerable saving over the previous master layout table with a steel top requiring machining (Fig. 9). As these tables must remain true, the stability of the magnesium tooling plate has proven itself in this application. Also, the overall cost, using tooling plate, was less than the steel table.

Fig. 9. Master template table-top of steel — previous construction (no longer used).

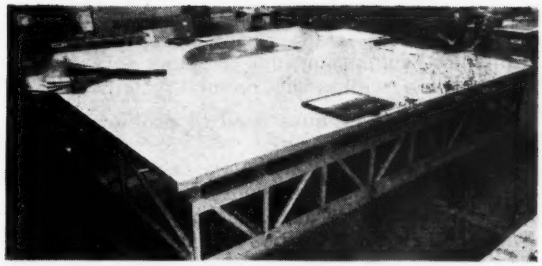

Fig. 8. Master template table-top of magnesium tooling plate— 707 body layout.

As a base plate for plaster forms, tooling plate has found wide usage. Its flatness, stability and rigidity with light weight has provided an excellent material.

Welding jigs that must be positioned by the operator are much lighter and easier to handle made of magnesium. Weld spatter does not stick to magnesium and local heating causes little warpage due to the high heat conductivity. Also, being non-magnetic, it causes no interference when used for spot-welding jigs.

A master gauge of magnesium tooling plate (Fig. 10) for the 707 strut will be flown to England to control the Rolls-Royce jet engines used on the BOAC order. Here, light weight combined with stability and stiffness was a controlling factor. The base plate and header plates are magnesium tooling plate. This was built at Rohr Aircraft to Boeing designs.

Scaffolding is usually of welded construction for the portable, high-reached type used around the vertical fin on large aeroplanes. Unless a high degree of stiffness is provided in the scaffolding structure, an undesirable springboard effect results. Magnesium alloy channels, angles and tread-plate provide a light-weight, but stiff, structure. The high-efficiency welds, 95% for magnesium versus 55% for aluminium, permit a lighter structure, as weld reinforcement and gussets are not required. Also, for a given weight of tread plate, the thicker magnesium prevents the springiness of thinner tread material. Confidence in scaffolding is enhanced by a feeling of steadiness and

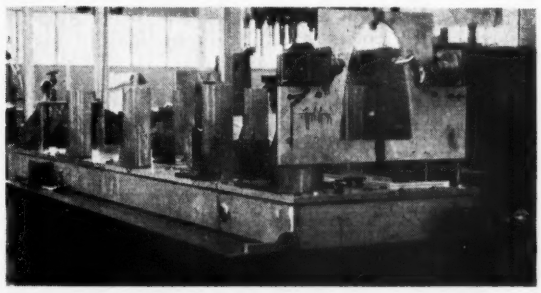

Fig. 10. Master gauge of 707 strut using magnesium plate for base plate and headers.

stability on the upper reaches of four and five level scaffolding. Cost is always an important factor in scaffolding, and magnesium compares very favourably, costwise, with other structural materials.

method and techniques used to produce magnesium tooling plate

ingots produced by continuous casting process

Ingots for rolling magnesium tooling plate are cast in a continuous vertical mould and are cut off by a flying cut-off saw in 2,000 lb. ingots 11 in. thick. The surfaces are trimmed free of defects and then rolled into plate on an 84 in. reversing hot mill with a capacity, in 1½ in. thick, of 6 ft. wide × 24 ft. long. The maximum thickness ordinarily produced is 3 in. The oven flattening is done at 550°F for 12 - 16 hours between accurate cast iron plates. This stress relieving results in excellent stability. A welded jig or fixture of magnesium tooling plate should be stress-relieved by holding 15 minutes at 500°F.

advantages of magnesium

abundance

Magnesium is the third most abundant of the earth's metals, and is obtained from brine wells and from sea water. It forms 2.1% of the earth's crust (iron forms 5%). To give an idea of the quantity of magnesium available, consider that one cubic mile of sea water contains four and one-half million tons of magnesium, or that 1,000 gallons contains 10.9 lb.

With an inexhaustible supply of raw material, the effort in cost reduction has been directed toward more efficient production and wider distribution. That this is being done shows in the steadily decreasing cost of magnesium tooling plate, whereas in most other tooling materials the cost has been steadily rising. In a period where economy is the watchword, an investigation of savings resulting from the use of magnesium tooling plate is justified.

cost saving in tooling

The lower first cost of magnesium tooling plate is sometimes evident in less cost-per-plate, or, in other cases, in less cost-per-unit volume compared to aluminium. The figures in the tables below are probably not exact now, but serve to illustrate the trend.

fabrication costs

The ease of handling of the raw material is an important factor in any tooling shop. Being able to dispense with power handling equipment in many cases is a saving in the equipment, as well as the waiting time for the equipment to arrive and perform the required move.

The speed at which magnesium can be machined is indicated in Table II.

TABLE I
COMPARATIVE COSTS OF 1 in. THICK TOOLING PLATE (4 ft. × 8 ft.)

Material	*Weight, lb.*	1 *piece*	40 *pieces*
Cast Aluminium ...	472	$382.32	$10,761.60
Magnesium ...	301	$299.80	$9,487.52

A more complete analysis of machinability is covered in "Metal Processing" by O. W. Boston and in "Machining Magnesium" by The Dow Chemical Company.

saving in using — shop areas

Again, the light weight of a tool that will perform the same requirements as a heavier steel tool, shows an advantage in the sub-assembly shops as well as in the final assembly areas. This has been covered in detail previously, but is re-emphasised to bring out another point, the fact that magnesium tools' light weight makes for a tremendous saving in man-hours lost due to injuries.

justification for using new material

No one makes the claim that by using magnesium all tooling trouble will vanish, but rather that savings can result from its proper use. There are applications where no saving would result, nor would it be as suitable as other materials.

There is a definite place where the use of magnesium in tooling will result in a saving in time, which is money, as well as the basic cost of the material, magnesium.

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TABLE II
RELATIVE POWER REQUIRED TO MACHINE METALS

Metal	*Relative Power Required*
Magnesium Alloys	1.0
Aluminium Alloys	1.8
Brass	2.3
Cast Iron	3.5
Mild Steel	6.3
Nickel Alloys	10.0

DESIGNING FOR QUALITY

by C. R. WILKINSON, F.B.S.I., A.M.I.W.M.

Director, Howlett & White, Ltd.

(Branch of Norvic Shoe Co. Ltd.)

After serving his apprenticeship with Howlett & White Ltd. (a branch of Norvic Shoe Co. Ltd.) Mr. Wilkinson was responsible for production equipment and patterns and during that time became responsible for last design and development. In 1947, he became Manager in charge of the Research Department and became a Director of the Company in 1959.

Mr. Wilkinson presented this Paper to the Conference on "Quality in Industry", held at Buxton in June, 1959, and organised jointly by The Institution of Production Engineers, The Institution of Engineering Inspection and The British Productivity Council.

DESIGNING for quality can, broadly speaking, be interpreted in two ways. We can either discuss the actual design of an article — a single aspect — or we can consider the general picture of everything involved in its volume production. This is the overall picture I prefer to take, as — though it is very true that quality can be introduced at the design stage — many other factors are equally involved, and all play a part in quality initiation and maintenance.

It is a picture, too, with which citizens of Norwich (where I come from) are familiar, having been raised in a city which justifiably claims quality in so many of its products. Fine worsteds were originally produced in the village of Worstead, 10 miles away; Norwich mustard and winches travel the world. Norwich has long been known in shoemaking as a "quality" centre for ladies' shoes, and we have learned quality the hard way. We have long known that quality is not achieved by accident but by design, and that only constant vigilance will maintain it.

As can be seen from the printed programmes of this Conference on "Quality in Industry", this contribution comes from the world of footwear. This industry — and they are few indeed who do not make use of its products — has a strongly-marked craft background. Its beginnings are rooted firmly in the excellence of personal achievement, and pride of craft blooms naturally. The strain has continued through succeeding generations of inbred quality.

It is inevitable when first thinking about such a Paper as this that the thought is not long in arising that engineers have a much better chance when

fabricating to standards, than we shoemakers do. Their materials are, broadly speaking, stable ones. A steel plate 6 in. × 6 in. × ½ in. stays 6 in. × 6 in. × ½ in. and any number of them can be expected to be the same. Leather is a very different story. It is a natural "grown" material, no two skins of which are exactly the same; moreover, no two pieces cut from the same skin behave in exactly the same way. It is a "live" material whose characteristics of stretch and plasticity are exploited to the full in the making of boots and shoes which must contain quality in the necessary elements of function, comfort and appearance if they are to appeal and sell well. It is only by appealing and selling that a living can be assured, and no one knew that better than the old shoemaker craftsman who took his own measurements, painstakingly made his pair of shoes and who had to receive customer reactions, good or bad, personally. Finally, in smaller communities, he had to live with the performance of his product. If it failed, the shoes were back on his bench and his personal reputation suffered. He soon learned that quality avoided trouble, that quality meant business, and that good business brought a good living.

It could well be remarked that what I have just said about shoemakers could with equal force have been said of masons, wheelwrights, weavers or any other of the early craftsmen who saw their own job right through. It is natural, however, that I should take him as an example, since after spending all my working life in his world I should know him best. He is to my mind, moreover, a perfect example, illustrating in particular the master-apprentice relationship which taught him his trade.

As well as purely constructional details, the master could usually be relied upon to impart and create quality standards. He would be ruthlessly critical of faulty work, and could drive his points home by a system of fines. He would find better ways of doing things and instruct his workmen accordingly. His teaching was personal and pertinent; and continuous. A century of movement from "master and man" to modern factory methods has done nothing to reduce the need for this personal teaching. The displacement of the intimacy of the old small workshop by the relative impersonality of vaster assembly plants merely emphasises it. Teaching, or training, or by whatever "clever" name it may be now known, is a factor of prime importance in any scheme for quality in industry. It is a number one essential in any overall design for quality.

importance of sound teaching

This teaching must be more than adequate. It must do more than merely state just *how* a particular operation must be performed; it must tell *why* it should be that way. On an assembly line, the skill with which any one operation is performed affects in marked degree the success with which following operations are done. It is surprising how many operations, complete though they may be in themselves, are really preparatory ones for later operations or processes. Quality in the finished article is the sum total of many small operations all well performed. Operations were performed well because their own needs and their effects on the next ones were fully understood. The old master shoemaker knew this well, and taught his apprentice soundly. The teaching of modern management concerned with whatever it may be fabricating must do no less.

To instruct in the motions which enable a job to be performed is not at all hard. It is much more difficult to add to this instruction that refinement which admits the element of quality. It goes without saying that unless the teacher himself is quality-conscious, it will never arrive. Not only must he be able to talk quality, he must be able to indicate it. He should be able to do it himself, and get across to his pupil the improvement to be expected from later operations by the betterment of the one in hand.

To the initiation of quality must be added its maintenance. This was far easier in the older days, when the workman himself completed the whole article. Falling short at any one operation created later difficulties for him and therefore encouraged his best efforts all along the line. He was consequently his own examiner and would reject his own shortcomings. The worker performing a single operation in the chain does not himself have to overcome the difficulties caused by his own standards of work, and in fact — unless already pointed out to him, by correct instruction — may not even realise the results. Maintenance of quality by examination by others must, therefore, be a feature of modern manufacturing lines.

Whether this examination be by expert static examiners at selected points or by roving examiners is open to much discussion. The fabrication of differing articles under differing conditions probably makes a hard and fast ruling impossible. Each case must be taken on its own merits.

Modern techniques throw up ideas such as statistical quality control, process control and others, all of which make valuable contributions to the problem. Their cases for and against are best not argued in this Paper, particularly as my colleague Mr. Sychrava, more actively engaged in this research than I, will doubtless deal with them in his contribution to this Conference. I would prefer to stay with my own subject, believing that by constantly talking and teaching quality, an attitude of mind is born. We all begin to "think" quality, and each in the manufacturing chain becomes his own examiner, instinctively rejecting lower levels of performance, so reducing the need for inspection by outside examiners.

In addition to efficient job education, any design for quality must start on the drawing board. There is no more certain way of lowering quality in the finished product than by including elements in the original design which are outside the scope of the plant, or beyond the ability of the labour available.

Unless it is planned to purchase specialised equipment for the production of some item in the design, everything in the conception must be handled easily by existing equipment. That way, following efficient process education and quality control, lies success;

each unit will be the best possible. To endeavour continually to manufacture beyond the scope of existing plant must result in so many failures and so much bickering between management and workers, that a sense of frustration develops on both sides. This can do nothing but harm. Reaching out is all very well, but over-reaching of this kind creates disharmony in production and low standard of quality. Low quality can mean poor performance in the hands of the consumer, a certain means of lost business.

advantage of simple design

Designers must be ever on their guard. The simple design, well made and of good performance, will win every time over the more complex one which, by being a continual headache to make, tends to fall steadily below standard. Unnecessary embellishments contribute nothing to performance and are often a hiding place for the "good enough" outlook. Clean, smooth, flowing lines provide no such hiding places.

In the overall design for quality the specification, the selection of the right material for the job, are all important. To return to my own industry for a moment, let us consider leather. Leather makes belts to wear, and belts to transmit power. It makes clothes and pump washers, fancy goods and harness. The ancients wrote on it and coaches swung on it. All these very different things come from an animal's back, some of them from the same animal, the important difference being the way in which the raw material is prepared for its special purpose.

Leather for footwear differs in some way from all these, and there are as many grades and types for differing footwear needs. Only by using the exact type for any one particular purpose can goods of the best quality be made. Only one will have the correct characteristics and behave in such a way that manufacture to the desired quality is practicable.

It may well be that after a specification has been agreed upon, some factor will make a departure from the standard necessary, and in this lies one of the enemies of quality. The trained shoeman will meet changed leather characteristics by his own skill and machine adjustment to the limit of his and the machine's ability, but if the material beats him, quality will suffer.

If this is true of the shoeman, it must be equally true of other industries. In this event the worker should not be blamed. Management at all times must assume responsibility for the setting and for the maintenance of specification — for the selection of the right material for the job.

The emphasis in the preceding paragraphs has been on leather. It is the very foundation of my industry and it seems that as long as there is an animal on earth it will take its share in keeping us shod.

That does not mean, however, that every little bit of footwear must always be made of leather, admirable though it is in so many ways. Modern research and development have resulted in the introduction of components of materials other than leather for particular purposes. They have been substituted for leather because they possess special features of "fitness for purpose" which in turn raises quality in performance. For instance, the waist of a shoe — that part bridging the space between forepart and heel — is today commonly supported by a shank piece of spring steel. Being resilient and strong for its size, such a component is obviously extremely suitable, particularly in the case of ladies' high-heeled shoes. Similarly, the original almost universal use of leather for toe cap stiffening has given way to a whole range of toe stiffeners either celluloid-based, thermosetting, or of self vulcanising rubber which make toe ends of shoes anything between rock-hard or glove-soft according to the purpose of the particular shoe. This principle is undoubtedly true of other industries. Critical examination of what is expected of a component can result in the use of a material other than a traditional one, and can promote easier working, a more uniform standard of product and a better article for the customer. Specification is a most rewarding field of research, often resulting in the discovery of elements of triple virtues — production economies, regularity of product and improved performance. Specification is truly part of any design for quality.

machinery and equipment

Of no less importance is the question of machinery and equipment. The footwear industry, like many another with a craft background, has over the last 100 years or so, been steadily mechanised with a succession of machines of ever-increasing complexity. Owing to the "live" nature of a shoe upper constructed from variable materials, nearly all our machinery amounts to devices which perform mechanically many of the original hand operations. Ranges of adjustments allow the skilled operator to compensate for local stretchiness or tightness and so produce pairs of shoes which are finally alike in measurements.

Newer and better machines are continually coming along and the wide-awake shoe manufacturer examines them all, as, indeed, must progressive manufacturers of any other product. The one thing that every manufacturer looks for is whether the new version or the fresh conception does the job better. It is a natural urge.

Frequently the improvement takes the form of interchangeable parts to match different shapes or conditions. Best results — and improved quality — are only achieved if these parts are used in their correct context. Great care should be taken to see that operators fully understand the need for these changes and carry them out correctly. Not to do so must result in the lowering of quality standards. Again, it is management's responsibility to see that operators are correctly instructed not only in the machine operation, but in the why's and wherefore's of the job, and in the effects that will be encountered further along the line if their operation is not performed accurately using the correct equipment. It is here that the good foreman or supervisor proves his worth. In a modern shoe factory he is the direct

descendant of the old master shoemaker, guiding and chiding his apprentice. It is he as much as anyone else who can jealously guard quality standards.

Makers of small auxiliary machines are continually producing ingenious arrangements which successfully combine, in one operation, two original hand fashioned ones. Shoe manufacturers always have an engineering staff, and one or more among them can usually design and construct simple jigs which make the performance of bench jobs easier and more regular. Though originally the thought may have been to speed the job, a commonly found additional result is to achieve a new regularity of product, a setting of a controlled standard of quality from which further advances can be made and measured. The less dexterous worker can achieve results attained by the naturally more skilled and his ideas appreciate accordingly.

No design for quality is complete without a continuous search for better and more positive methods of assembly, a careful examination of machine advances and an ever-watchful eye on machine operation and maintenance — an item of particular interest to shoemakers and those engaged in garment making. Both of these employ great numbers of girls on various types of high speed sewing machines. These girls work fast and their skill at stitching operations is notable, but as would be expected, their knowledge of machine maintenance is often limited to the simplest of adjustments.

Nowhere in these two industries is quality won or lost quicker than in the machine rooms, and there is no more certain way of losing it than by allowing the efficiency of the machines to fall. The only possible way to maintain it is to have the full-time services of resident sewing machine mechanics who continually move around the department, maintaining these highly efficient yet temperamental items at maximum efficiency.

It is significant that in America some footwear factories are extending this idea to cover all departments. In an endeavour to maintain all machinery at peak efficiency, even routine lubrication is being taken over on a daily and weekly basis by permanent staff. This policy allows the shoemaker — who tends to be more craftsman than mechanic—to concentrate on making shoes and, it is claimed, pays off by reduced outside servicing and replacement charges.

Machine maintenance costs money. It must be spent if repeats, born of quality of product, are desired. Indifferent equipment has no place in any "design for quality".

In this very rapid survey of essentials in any design for quality, something must be said about the creation of the conditions under which quality can be expected to flourish.

attitude of mind

Quality arrives as a result of an attitude of mind. This cannot be expected to be bred under incompatible conditions. What may be admirable in a moulding shop could spell death to fine fabrics or leather.

If cleanliness is necessary for quality, then away with all unclean elements! If hot hands mar materials, then provide gloves. If laying the product on a bench damages it, then protect it by covering the benchtop suitably.

Accord the product every dignity. Set it on a pedestal and underline the fact that it is the sole reason for the existence of the factory making it.

Never let machine lines submerge it. The machines are important, but they are there to serve the product, not to dominate it.

Arrange for correct receptacles and transport for the product. Let them be of the kind which handle it suitably and sympathetically. And preferably — especially in the case of articles fabricated from fine materials — let them hold them singly and visibly. The goods should always be on view. They are the most important thing in the department and it should be made obvious to all.

The footwear industry has long ago given up large receptacles which hold quantities of work all jumbled up together. Such practices cause bruising and damaging of fine leathers and are time wasting for the operative. Shoes still on the lasts are held on pegs in trays or racks and kept apart from one another. Shoes off the last are rested in felt-lined sections — and management can score yet again by designing receptacles in a way that presents the shoes to the operator in a manner economical of time and trouble.

If more light is necessary, get it. If noise is distracting, abolish it. If a pink ceiling helps, then paint it. Nothing should be considered too much trouble.

All these things, and perhaps many yet unthought of, are necessary ingredients in any design for quality. They create the climate which encourages the right frame of mind, and it is just that which raises quality levels. Management wants quality and must overlook no means of getting it.

I have endeavoured to set down for your consideration the things which I believe are necessary in any "design for quality". To sum up, they are — though not necessarily in order of priority :-

1. Training — complete and imaginative.
2. Designing — within limits of labour and plant available.
3. Selecting — the most suitable materials for the job.
4. Searching — continuously for improvements in plant "know how".
5. Creating — ideal conditions, compatible with the product.

These items are all within the control of management. They must all be achieved for full realisation of any design for quality.

OPERATOR CONTROL

by R. K. GRUNAU, M.I.Prod.E.

Chief Inspector,
Rolls-Royce (Oil Engines) Ltd.

Mr. Grunau was educated at the Technical Faculty of Vienna University (Technische Hochschule), where he studied engineering. He joined the Raleigh Cycle Co. Ltd. (now Raleigh Industries Ltd.) in 1938, as Tool Designer. He subsequently held a number of production positions on tool design, planning and plant and process layout, and was also instrumental in introducing statistical control as applied to the production of shells on automatic machines. In 1949, he was put in charge of all overseas planning and the purchase and provision of the necessary plant and tooling of the overseas projects of the Company.

In 1951, Mr. Grunau took up his present appointment as Chief Inspector of the Oil Engine Division of Rolls-Royce Ltd.

He is Past Chairman of the Institution's Committee on Control of Quality, and presented this Paper at the Conference on "Quality in Industry" at Buxton, in June, 1959.

AFTER a period in which quality engineers have been in doubt as to the production stage at which the quality of a product should be verified, it is now increasingly accepted that the best time and place to look for faults or deviations from specification is wherever and whenever they are being produced.

In view of this, patrol inspection systems have found their way in to the production shops in the last decades, but it became increasingly obvious that the ratio of inspection to direct labour would have to be proportionately high if inspectors were to be used to check a large percentage of all qualities at the source of their production.

As an alternative, statistical methods recommend themselves, but they must be regarded as limited in their efficiency and application, and hence, where a quality article is to be produced additional inspection facilities may have to be provided. It should be appreciated, however, that no matter how many facilities are introduced after the production of rejectable materials, the result is rarely 100%.

From the human relation point of view, the picture is perhaps somewhat further from the ideal. While the production and quality departments should ideally work as a team to achieve the same end, in many factories there is a tendency for the two departments to be involved in a tug-of-war, where the production personnel concerns itself more with quantity than quality and believes the latter to be the sole responsibility of the Inspection or Quality Department. Yet how can this be, when quality

Fig. 1. Operator checking bore and height of rocker pedestal within machining cycle.

depends so much on things that have gone on long before a product ever reaches the manufacturing stage ?

Resulting from this train of thought, two major conclusions can be drawn :

1. If inspection is to act as a sorting machine, which means that managements expect production to produce a great number of faulty components, then there is no alternative but to employ a large number of people to do this sorting, with all its inherent inefficiencies. An exception to this is, of course, the factory which employs inspection as sorting personnel, where the high quality requirements cannot tolerate even the smallest percentage of errors to creep into the final product.
2. If inspection is only employed in an organisation as an aid and guide to quality, then their numbers will be necessarily smaller, but their responsibility cannot cover the whole of the production, as they can only see a percentage of the factory's output, and the burden of quality must necessarily be spread over the whole of the organisation.

As the latter scheme is by far the more economical, the trend in recent years has been to prevent scrap from occurring rather than to find it after it has already taken place. In line with this policy, a new scheme under the heading of Operator Control is being introduced in a number of organisations both at home and abroad, and it is the purpose of this Paper to enlarge upon the benefits and limitations of this scheme.

Operator Control, or in other words, the control of one or more qualities by the man who actually produces them, has a number of advantages :

1. The shop floor organisation will become one unit, with Production and Inspection Departments working together for the same objective.
2. Scrap, rectification and salvage will be reduced to new low levels.
3. Increased control of, and reduction in the cost of, inspection.
4. Improved consistency of products which cannot be other than favourable to increased prosperity.
5. A tendency to relieve the monotony of repetitive operations and hence reduce operational fatigue; and, finally
6. Over the years an eventual creation of or increase in pride of workmanship on the shop floor, which cannot fail to have its effect on the individual, his work and his outlook.

Whilst all these advantages are factual, the introduction of Operator Control in an existing plant or factory is by no means easy. The greatest care has to be taken in the planning stages and operations and personnel must be carefully selected.

The operations which lend themselves best to this scheme are those which are continuous and where operators are using a machine or performing the same function on a continuous basis.

The basis of the approach to piece by piece inspection by the producer is, firstly, the introduction of suitable inspection equipment and the essential qualities of this equipment must include :

1. speedy application;
2. ease of interpretation;
3. continued accuracy.

Only by the provision of such equipment does Operator Control become practicable, but if such equipment is provided it is immaterial whether or not the operator in question comes under the heading of a skilled machinist.

Economical and quality considerations must necessarily go hand in hand, hence there must be a sensible relationship between the time taken by the operator to do his operation and to do the subsequent verification. Here again we can categorise into :

1. Operations where the operator has time to check the conformance to specification within the machining cycle, either while the actual operation takes place or during the operation of the following piece. This is the most satisfactory application, but if Operator Control were confined to this type alone, it would obviously have only limited application.
2. Operations where only part, or none, of the operation cycle is available for checking the process. Not only is the design of speedy inspection equipment, in this case, very important, but in addition, the economics have

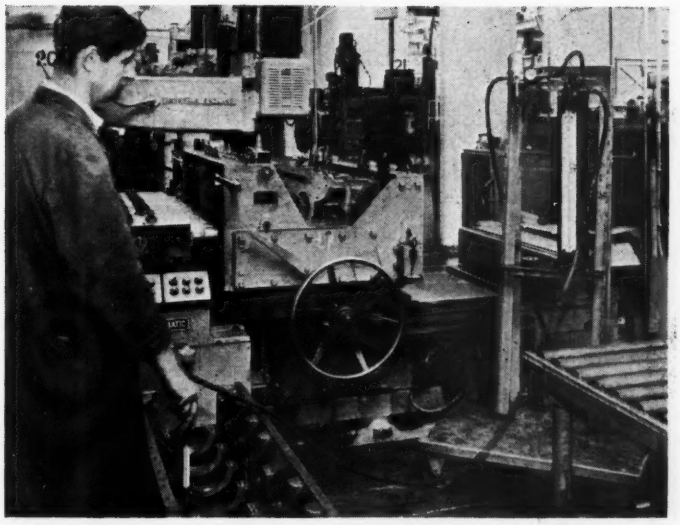


Fig. 2. Operator checking tappet bores on crankcase outside machining cycle.

to be studied carefully. Such points as importance of component and its qualities, cost of equipment, time taken for checking and operating and their relation to each other, have to be considered. It is quite within the scope of this scheme to allocate the control of certain qualities of a product to inspection staff and others to operators, providing the division of the responsibilities is clearly defined.

Another way to reduce machining or plant idling time to a minimum is to reduce the percentage of pieces to be inspected by the operator.

Invariably, decisions for or against the scheme have to be made with the full knowledge of the individual application, and it is hardly possible to generalise even within the framework of any one industry.

But this should be borne in mind : that a small loss of productivity may be far outweighed by the advantages which can be gained by the introduction of Operator Control.

When discussing the economics of the scheme, the question is invariably raised as to how operators should be rewarded for their additional duties. If a ratefixed factory is considered, where operators are paid on an incentive scheme, it is important to time the inspection operation and include it in the respective floor-to-floor time. Beyond this, operators should be encouraged to declare rejects. It is quite practical to pay the operator for a limited amount of scrap providing he declares it himself.

The scheme lends itself better to a factory where workers are paid on a classified hourly rate, and where shop supervision has the task of setting the pace. It is, however, possible to introduce it with satisfactory results in a factory where incentive schemes are operated, providing the production management remember to trim the incentive scheme to the requirements of Operator Control, and operators are not penalised for declaring rejectable work.

The role of the inspector in this scheme remains one of importance, and although his numbers will not perhaps be as large as in other schemes, he will have to possess the normal attributes expected of an Inspector, to the fullest measure : tact, inspection skill

(*continued on page* 495)

Fig. 3. Operator checking alignment and size of main line bore on crankcase outside machining cycle.

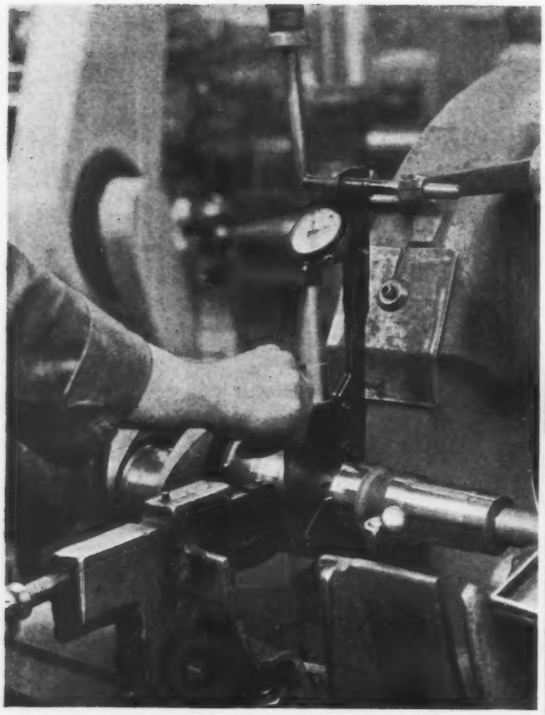
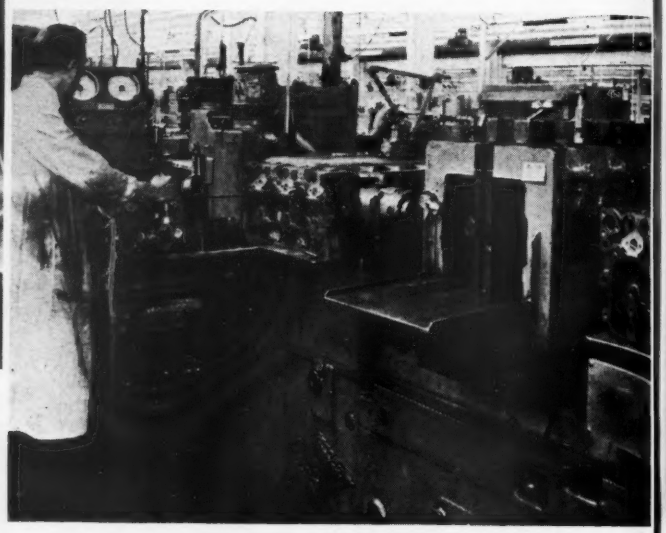


Fig. 4. (Above) Operator checking size of journal whilst grinding.

Fig. 5. (Below) Operator checking size, depth and concentricity of valve seats within the machining cycle.



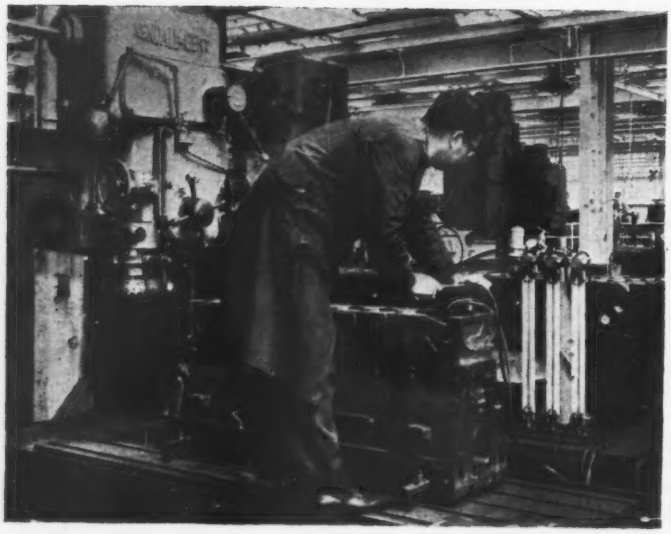


Fig. 6. Operator checking squareness of liner bore to cylinder head joint face outside machining cycle.

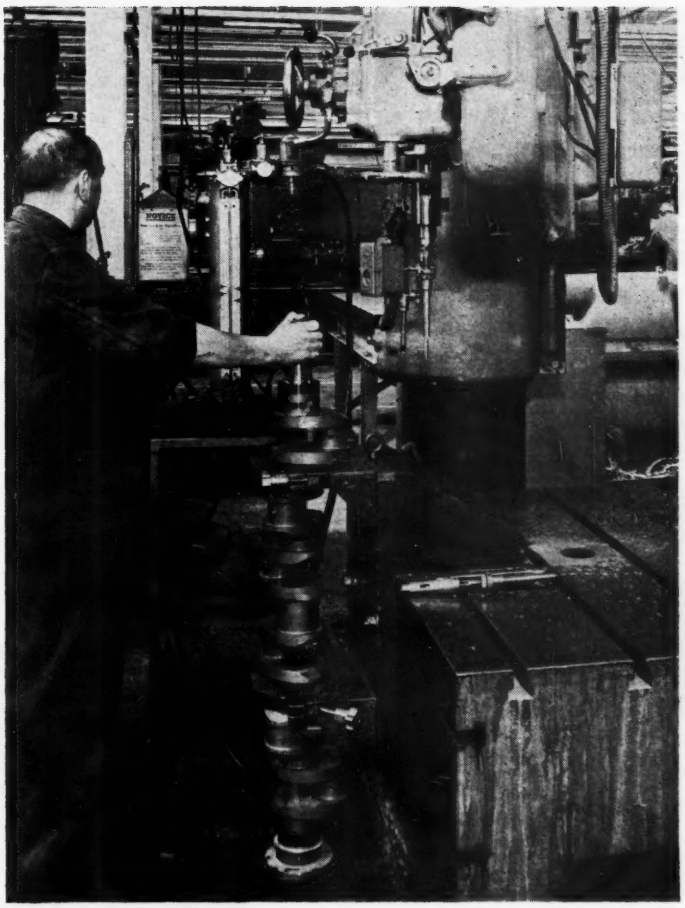


Fig. 7. Operator checking size of dowel holes outside machining cycle.

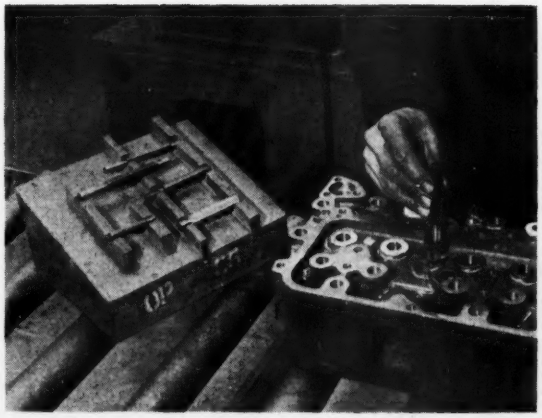


Fig. 8. Operator using standard plug and screw gauges on cylinder head outside machining cycle.

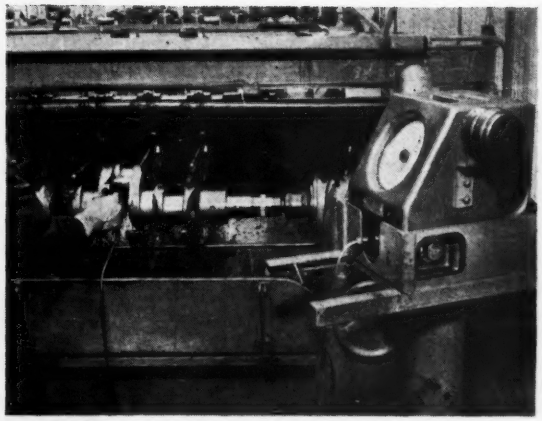


Fig. 9. Operator checking size after lapping of crankshaft pins outside machining cycle.

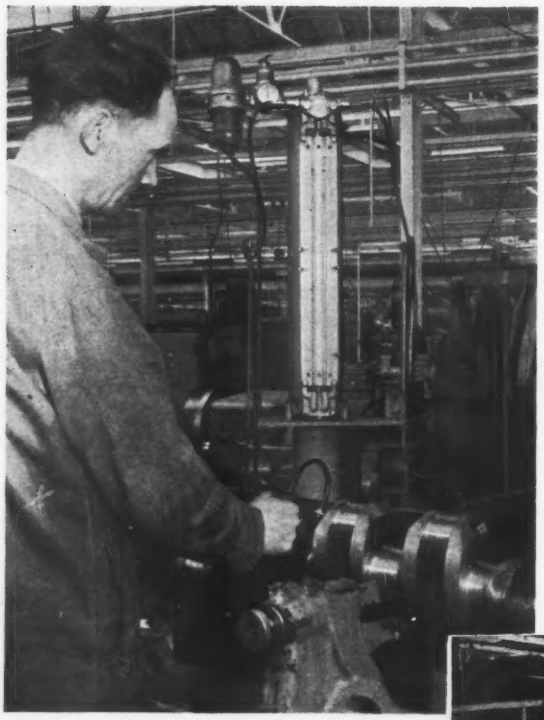


Fig. 10. Operator checking size of journal outside machining cycle.

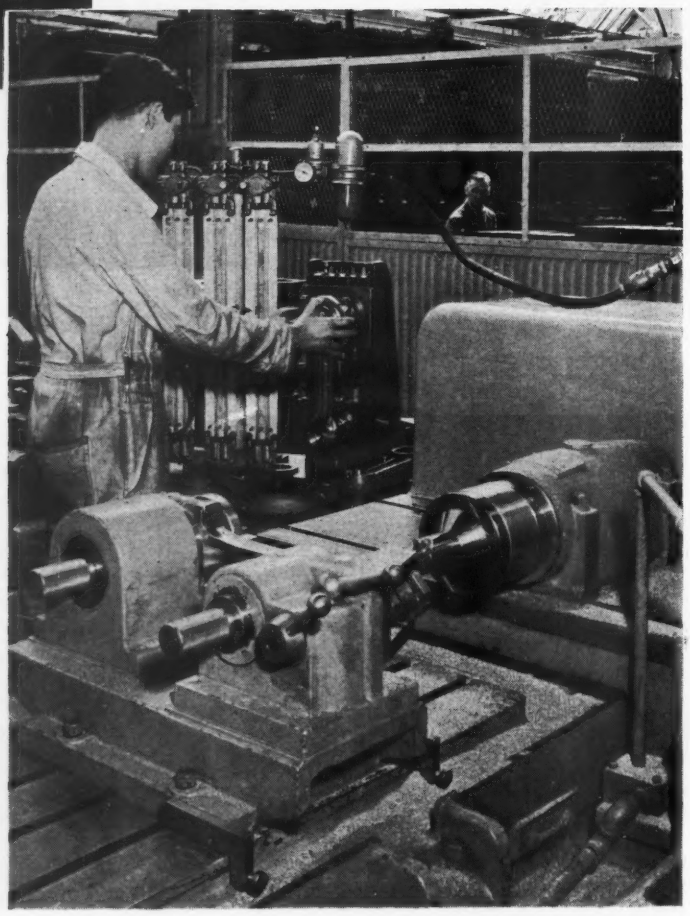


Fig. 11. Operator checking size and alignment of conn rod bores within the machining cycle.

and manufacturing knowledge. The duties of Inspection staff under this scheme will be firstly to ensure that the inspection equipment provided is in working order and is functioning correctly. Their responsibility will also cover all other aspects of quality, particularly the education for quality of semi-skilled operators. The inspectors will have to be available for decisions affecting operator's rejects and they will have to ensure that processes are started correctly when new plant or new tools are being brought into operation. Finally, their time should be used to furnish management and Quality Department with Quality Audit Reports based on a percentage of the output.

Under this scheme of Operator Control, the status of the Inspection Department rises, and the criticism sometimes expressed against this scheme, namely, that with reduced numbers the role of the Quality Department is of lesser importance, is not justified. On the contrary, the true value of efficient Inspection staff on the shop floor will be appreciated by production personnel, and the change of atmosphere in a shop working under this scheme can be quite remarkable.

As operators are working for production, it is essential that the scheme should have the full support of Production Management — for this reason, it can only be successfully introduced by the senior official in charge of all manufacturing activities. He must remember — and I should like to re-emphasise this — that proper planning is the ruling factor. Unless actual functions and inspection operations are carefully and adequately allocated, nothing but chaos will result.

The introduction of the scheme alone is, in my opinion, only the beginning of a long-drawn-out process and at no stage has any form of finality been achieved.

It should be remembered that it will take time to create an atmosphere of quality which should be allowed and encouraged to spread throughout the whole of the production organisation.

To sum up, it is, I think, possible to state that under modern working conditions the integration of production and inspection to some degree or other is an accomplished fact. Operator Control takes this integration one step further, and the not entirely unexpected experience in the course of its introduction is, that one unexplored avenue leads to another, and operations or processes which are, in the initial stages, considered to be quite outside this scheme, are eventually found to be practical propositions.

The Machine Shop or the Processing Shops are not all the applicable production activities. Fitting and Assembly Departments, Packing and Despatch Departments can be, and are being, drawn successfully into the scope of the scheme.

With the advent of automation, Operator Control will be partly replaced by automatic machine control and automatic gauging equipment, but many industries have a long way to go before automation becomes a reality in their field. Operator Control should therefore serve as a highly competitive means for achieving consistent quality and so help us to secure and hold our vital export markets.

MEMBERS TRAVELLING OUTSIDE THE UNITED KINGDOM

Members who are visiting Australia, New Zealand, India, South Africa or Canada, are reminded that the Institution has local Sections in these countries, where they will be made very welcome by the Institution's Honorary Officers and members there.

Papers on subjects of interest to production engineers and managers are always welcomed, and any members who are visiting one of the Sections outside the U.K., and who would like letters of introduction, should inform the Secretary of the Institution at 10 Chesterfield Street, Mayfair, London, W.1.

PLANNED ORGANISATION FOR QUALITY PRODUCTION — (*concluded from page* 502)

standards and blacklisting of those sub-contractors who consistently abuse the main contractor's resources for economic reasons. On the other hand, it could be said that you only get what you pay for, so probably we have a contractual problem as well as a technical one.

conclusion

In conclusion no one will disagree that the aircraft industry is a "natural" for the introduction of quality control. With so much inspection required and so much detail planning to ensure accuracy, efficiency and a standard to be maintained compatible with the safety of the product, it is obvious that it is essential for our industry to go into quality control. Automation is just on our doorstep, although it may not be introduced into our industry as readily as others, and it must lead us into more highly specialised equipment, better and improved techniques of tooling, standards of handling, storage and a better standard all the way round in our organisation's different functions.

PLANNED ORGANISATION FOR QUALITY PRODUCTION

by C. E. S. BURGESS

Chief Production Engineer,
Bristol Aircraft, Ltd.

Mr. Burgess was educated at Kingston Technical College and served an engineering apprenticeship at Vickers-Armstrongs Ltd., Weybridge. In 1942, he joined the de Havilland Company as Chief Planning and Ratefixing Engineer, as part of a production team on Mosquito production. In 1947, he moved to B.E.A. as Planning Superintendent, leaving 10 years later to take up his present appointment.

He presented this Paper to the Conference on "Quality in Industry" at Buxton, in June, 1959.

"AVIATION IN ITSELF IS NOT DANGEROUS, BUT TO AN EVEN GREATER EXTENT THAN THE SEA IT IS TERRIBLY UNFORGIVING OF CARELESSNESS, INCAPACITY OR NEGLECT. SAFETY IS NO ACCIDENT."

THERE is a sense in which safety and quality are synonomous terms. One could say "quality is no accident" and it is built into the product from the earliest stages. Far from being the all-too-late Inspection stage, it must be designed and planned into the job at the outset.

A lot of lip service has been paid in the aircraft industry over many years to the idea of introducing quality control in the early stages of pre-production. To a large extent such a procedure was intended to obviate the difficulties and frustrations of achieving a reasonable standard by mutual agreement with Inspection and Supervision on the floor. This situation still exists in the aircraft industry because we appear unable to introduce in the early stages sufficient methods of inspection, production aids, tooling and equipment, to ensure that the product when built has the minimum amount of inspection.

There is no doubt in the writer's mind that the problems we have to face in the future will be 10 times greater than those which we are at present facing, and 100 times greater than we have had to face in the past. With the aircraft getting larger and faster, with high altitude problems and the new era of supersonic flight, a very much higher degree of

accuracy of component manufacture is required. New materials are being introduced which will not allow handwork and this in turn will introduce new equipment, new machinery and specialised equipment to enable these materials to be manipulated and cut by mechanical aids. With these new techniques will have to come a "new look" of inspection equipment, as this will have to be so closely allied with the production aids as to be identified with them and used concurrently to enable the product to be manufactured to tighter limits and specifications.

This factor alone makes it important that this standard is as high as possible compatible with the safety of the aircraft. Having said this I think it would be right and proper to get a clarification of what we mean in the aircraft industry by quality, as there are so many different interpretations in various industries. In this Paper I am devoting most of my time to technical efficiency of production and appearance. This obviously divides quality into two main categories :-

1. the technical efficiency compatible with the safety standards which the aircraft industry must attain to satisfy regulations;
2. the finish, that is, the general appearance of the product to meet customers' requirements and also for sales appeal.

As I have said before, a lot of lip service is paid in our industry to the need to introduce quality control in the early stages of pre-production. In my particular establishment, we have to a large degree put into practice what we have been preaching, and I hope that our approach to this subject will be of interest to most of the representatives of other industries.

I have attempted by going through the whole of the pre-production departments to establish what has been done, and what will be done in the next few years, when introducing this type of quality control in the everyday functions of the productive departments. I am firmly convinced that if we develop this approach in the pre-production stages, the frustration and arguments that go on at floor level over the standard of the different products will largely be eliminated. Unfortunately, in the aircraft industry the quantities are so small that we are, to a large extent, governed by the amount of money that we spend.

design

It is an accepted fact among production engineers in our industry that the Design Department tend to produce the most complicated shapes to test the production engineer's ingenuity in overcoming the problem of manufacture. This situation, which has grown up by custom and practice, has been due to the very wide gulf that lies between Design and Production Engineering. This position is being rectified in our establishment by a much closer link between Production and Design, by the introduction of a department between Production, doing pure production work, and Design, called Manufacturing Development, one of whose jobs in life is to ensure that the designer is kept fully informed of the production requirements which can be embodied in the initial designs. This will not only improve the production techniques, but will maintain the quality and standard which in our industry are so important.

The preliminary designs, the production joints, secondary joints and other components which are of major importance to the production engineer in the manufacture of all his main assembly jigs are all discussed long before they ever get to the detail design stage. With this closer tie-up between Design and Production there must obviously be another link which will come eventually when Inspection, whose prime function is to ensure that a high standard is maintained, will have to have their say in what inspection equipment will be required to comply with the new techniques that we have to master. Technical development is so rapid that unless this particular point is covered in the very early stages, inspection equipment is obsolete before it is ever utilised.

I am a firm believer that production tooling can incorporate a lot of inspection features which would reduce further inspection to a minimum. This can only be achieved by full co-operation between Design and Production Departments. There is a growing realisation in Design that apart from the safety regulations which, as I have already said, are part and parcel of the aircraft industry's attainment of standards, the quality must be of the highest compatible with the cost. Design teams are getting more cost conscious; hence one of these days we may see these irregular shapes becoming more regular and economical. Economic manufacture can only be achieved by complete understanding between technical departments.

planning

Ambitious target dates can only be set by ambitious and realistic planning. In the past it has appeared that target flying dates for aircraft might well have been set by gazing into a crystal ball, so unreal were they in their ambition. This has led to an overloading of labour, panic measures and a deterioration in quality. In the case of aircraft considerable preparation is necessary at the pre-production stage, the outcome of which is a programme based on sales and delivery dates outlining in a simple form the chronological sequence of completion of the various stages of manufacture. The fundamental problem which faces the Planning Department is the conversion of data, in the form of drawings, into simple instructions which will facilitate the manufacture of component parts with the aid of suitable tools and devices. Before planning and tool design can take place a programme plan must be formed, in order to indicate to all departments their commitments from start to finish.

One of the functions of a Planning Department is to ensure that drawing requirements, specifications, dimensions and tolerances are met, and to establish where inspection stages should be carried out, the

latter being determined by the nature of the project and the manufacturing techniques involved. The problem that has existed is the reluctance of the Planning Engineer to accept the fact that the inspection stages in all manufacturing processes are as important as the production manufacturing operation. To overcome this difficulty we have located Inspection personnel in the Planning Department. Inspection personnel in conjunction with the planning engineers decide inspection requirements and ensure that the process calls for the varying conditions, such as :-

1. those inspection stages which are considered to be essential and which must be executed at a given time within the stage build sequence;
2. concurrent inspection which can have some degree of elasticity and will not necessarily interrupt production.

In addition, there is a daily stream of alterations to processes due to modifications, drawing changes or revised methods which have to be vetted for all operations, both manufacture and inspection. We have found that this arrangement has proved highly successful and satisfactory in practice, invaluable and now indispensable where close stage build sequencing has been introduced to maintain a smooth flow throughout the various build stages. In our industry continued pressure is brought to bear on the Planning organisation to introduce changes during manufacture. Full investigation is, therefore, necessary at all times to establish an agreed target, which as far as possible will satisfy all parties, especially the customer, and at the same time will not interfere with the production flow. It is desirable to embody as many technical improvements as possible and this requires complete co-ordination between Design, Planning and Inspection organisations.

Planning for quality may well replace " planning for quantity " which is a very well used phrase. Planning for quantity is a business we all understand and is a keystone and a fundamental part of a planning engineer's yardstick for his methods. This could well be replaced by a coined phrase " Planning for Quality Production."

factory layout

The part played by factory layout in ensuring that adequate facilities and services are provided to control the quality of the finished product cannot be overemphasised and the co-ordinated thinking of Production Engineering, Design and Inspection at the layout stage is essential to promote sound and practical techniques. If the high quality of the product is to be maintained adequate measures must be taken at all times to minimise damage, especially at the final stages. The mobile equipment used must be efficient, simple in operation and easily replaceable and this must not be allowed to deteriorate, as there is every danger that this would affect the quality of the final product.

It is one of the functions of the Factory Layout Department to maintain a close control on the maintenance and repair of this equipment. Planned maintenance of equipment is not new in industry, but few organisations have attempted to put into practice the recognised precautions to ensure that equipment has adequate maintenance. This the writer considers to be deplorable, as in his opinion, the phrase coined during the war by Sir Winston Churchill : " Give us the tools and we will do the job " could well be replaced by " Give us the maintained equipment and we will be able to give you the quality as well as the job ". Not only have we introduced some planned maintenance of equipment in our industry, but we are preparing to bring the work content involved into the incentive bonus scheme.

Budget control may promote a state of affairs which adds to the difficulties of maintaining quality. Departmental heads and frequently senior executives tend to regard budgets in too rigid a light. For example, expenditure upon small tools is usually included in machine shop budgets, and a case of the adherence to this predetermined level of expenditure which recently came to my notice detracted from the maintenance of a high standard of workmanship. The case concerned the supply of tools tipped with tungsten carbide, the provision of which would lower the production costs in man-hours and improve surface finish. But because the ordering of these cutting tools might have involved the department in accounting queries, the majority of the operators have to work with high-speed steel tools, with the consequent frequent regrinds and settings. Therefore, I must appeal to those who are responsible for budget figures to be careful they do not sacrifice quality in advance by too strict an interpretation of what is in reality a more or less intelligent guess.

production control

There are so many differing concepts of this Department that it would be as well to establish what is meant by " Production Control ". It is not an organisation which exists purely as an ordering department; the old Works Order Office concept is completely outmoded. It is an organisation which is responsible for translating the plan initiated in the Planning Department into detailed instructions and ensuring that raw materials, tools, kits of parts and labour or machine capacity are available at the right place, in the right quantities and at the right times.

One of the most important contributions of the Production Control Department to quality in the aircraft industry lies in the rapidity with which it can re-schedule production so as to cope with changes. This implies considerable flexibility in its administrative procedures.

I have said that quality is synonomous with safety in the aircraft industry and the price we pay is the high risk of obsolescence in our stocks of manufactured parts. This imposes upon the Production Control Department the responsibility of ensuring that stocks are kept to a minimum, and of taking rapid amendment or cancellation action on orders when changes are necessary. Due to small batch ordering, and to the obsolescence factor, buffer stocks cannot be

created and the whole Production Control and manufacturing organisation has to be constantly at readiness to deal with the emergencies which can occur in this situation, for example, from scrap occurring on the assembly line. This kind of action is always present in aircraft manufacturing and the shop loading section of Production Control normally allows for this by basing the advance factory loading on 80% capacity, allowing 20% as a contingency factor to cover these situations.

I have emphasised the contribution that the Planning Department makes in defining the sequence in which work is to be carried out. This plan can only operate if supplies are available, and it is Production Control's responsibility to see that they are. Non-availability of supplies can only mean out-of-sequence working, which means that the plan is not being carried out. There is a danger that out-of-sequence work can result in work already carried out having to be dismantled at a later stage, with possible loss in quality and certainly increased cost. In our establishment co-ordinating supplies is not an easy problem when you consider the possible conflicting demands of spares, modification kits, sub-contractors' requirements and two assembly lines. A Stock Control Department within Production Control is responsible for resolving items in short supply and allocating supplies.

It is inherent in the administration of Production Control's responsibilities that there is a considerable amount of clerical work in which accuracy is essential. It is also true to say that because of this volume of work the Production Control organisation may not be able to discharge its true responsibilities. The only answer to this problem lies in the use of computers for data processing, giving even greater rapidity of action and hence quality.

jig and tool design department

The main functions of jig and tool design are generally understood in engineering circles. What must be appreciated is the very close co-operation necessary between the various sections of production engineering to achieve the very high standard of product required in the aircraft industry. Statutory regulations demand certain checks to be made on major assemblies during manufacture, and it is the responsibility of the jig and tool designer to see that these are met; sheer necessity demands that a member of the Inspection Department is available to advise the designer as to the extent of these obligations. Jointly they devise and agree with the planning engineers responsible, the necessary precautions to be taken, and where necessary discuss these with the official authorities.

The utilisation of full-scale lofting plays an important part in controlling not only the quality of tooling, but also the dimensional accuracy of the finished component. The aircraft industry in particular provides an outstanding example of this factor. Because an aeroplane is devised of complex aerofoil sections, ordinates and lines, master lines must be established at an early stage in production and religiously adhered to throughout the whole cycle of the project. These loft layouts are used by both the planner and draughtsman as an aid in controlling the method of manufacture right through to the assembly stage. For example tooling holes, if required, are approved and standardised; all relevant holes and sizes designated by symbols are shown enabling the planner to call up matching holes in mating components with certainty. Where complex forms occur in a component, particularly in skin profiles, loft templates are cut and boxed up to simulate the outside skin-line of the component. By plastering in and splining the contour a master replica of form is obtained, and this can be used for the manufacture of plastic tools of various categories. A fully-drilled, lofted template can be utilised both for the manufacture of the drill jig and by the Inspection Department as a checking medium. It can be of particular significance after the tool has been in use for some time, when wear or creep occurring in the tool can be rechecked against the master template. In cases where the component is bent to contour or where flanges are required, the full-scale lofted template is often employed as a final check of contour.

new materials in tooling

As a generalisation, in production engineering a product is only equal in quality to the tool that produced it. This fundamental truth is sometimes overshadowed by the other factors that combine in controlling quality. Where small batch production is required the problem of quality control is made more difficult because the tooling used to produce the part must, of economic necessity, be as inexpensive as possible; for this reason any material that can be utilised in cutting costs while still maintaining quality should be used to the maximum. Materials in this category are produced by the plastic industry and already their application is growing as their immense value becomes apparent. In the U.S.A. and Canada their use has become commonplace whilst in the U.S.S.R. great interest has been shown. In this country, however, their rise to popularity has been rather slower. This, in the writer's opinion, is caused by two factors — foremost is the inherent distrust of plastics by the "steel-minded engineer"; secondly, and perhaps more important, is the manner in which plastics have been introduced to the industry in this country for toolmaking purposes. Whereas in the U.S.A. plastics are used as a new material within the existing toolroom structure, in this country the tendency has been to create a separate plastic shop to manufacture these "new-fangled tools" in competition with the orthodox toolroom, with ensuing disastrous results.

Why are these new materials useful in quality control ? The answer can be summarised under two headings :-

1. Ability to reproduce accurately complex forms;
2. Simplicity and economic application.

Epoxy resin possesses remarkable characteristics, among which is negligible shrinkage upon tryout (.001 in. per lineal foot, or .025% by volume). It is the ability to construct with relatively unskilled

labour, the ease and speed of manufacture, and the competitive prices of materials which place in the hands of the production engineer a ready-made method of controlling quality with particular emphasis on small batch production. By reason of the fact that the Epoxy resin can be cast, laminated or applied as a paste, it can be used in almost all branches of tooling. For detailed components, press draw tools, drop hammer tools, drill jigs, router templates can be easily made.

A noteworthy point to be mentioned here is that the plastic tool manufacture can be linked with full-scale lofting methods outlined in the preceding paragraphs. The boxed-up and plastered-in templates are utilised as a mould against which the press form or drop-hammer tools are cast. Similarly a laminate of fibreglass bonded with Epoxy resin and a suitable filler can be laid up against a lofted and drilled template with drill bushes suitably located, and an accurate drilling jig reproduced. The cheapest method of producing complex forms is by casting. Epoxy resin formulations are eminently suitable for this purpose; mixes and methods of production can be controlled from the Jig and Tool Office, thus enabling relatively unskilled labour to be employed once the know-how of manufacture has been acquired. The final cost of a tool made from Epoxy resin as opposed to orthodox materials will show a saving of up to 50 - 70%. It should be observed, however, that the greater the complexity of the form involved, the greater will be the saving.

assembly fixtures

One of the problems confronting the Production Engineer in his quest for quality production is accuracy in the assembly of major portions of an aeroplane. Broadly speaking, an aeroplane is broken down into major components, each one of which is assembled in its fixture and finally assembled as a unit at a transport joint. Controlled accuracy at these focal points is of paramount importance, not only to maintain the aerodynamic lines of the aircraft but also to achieve interchangeability of the major sections involved. By reason of the size of the assembly fixtures used in major portions of a modern airliner, checking the fixture location points cannot be carried out with orthodox methods. However, on fixtures of this nature the problem of thermal expansion and contraction must be considered. To assist in surmounting these problems, built-in aids for checking are incorporated in the fixtures of this magnitude. Datum plates are provided and a theodolite is used for siting positions and dimensions in the vertical plane and to aid horizontal checking; plates are cemented to the floor and have marked upon them the relevant station ordinates.

interchangeability

The problem of maintaining interchangeability constitutes one of the major headaches of any production unit. In our industry it plays a very important part. When it is considered that an aircraft of any real size could have up to 100,000 parts and a very high proportion of these are subject to change or replacement during the "aircraft's life", it can then be understood how important it is to be sure that this range of components can be removed and replaced not only easily in the most unusual circumstances, but with the minimum of delay. Maximum utilisation of aircraft is the lifeblood of any airline. One of the major requirements of an airline operator is ease of maintenance; this quality of an aircraft is dictated entirely by interchangeability and accessibility of the components.

work study

A few further words should be said on quality as distinct from accuracy. Strictly speaking, the former is a series of sense perceptions peculiar to each individual and is a purely subjective thing. It is only when standards of measurement within practical limits can be applied that we, as technical men, can say that a certain measure of accuracy will consistently yield a certain degree of quality. We must be clear on this point if a more or less fruitless academic argument is to be avoided. Quality in industry has largely been dictated by necessity arising from competitive forces engendered by war or commerce. As a result we have developed a more conscientious and logical approach to our problems which have now become, in the more progressive organisations, the application of scientific methods in industry under the general heading of Work Study.

It is interesting to note that the application of Work Study also embraces the fundamentals of another branch of science, i.e., economics. This is not generally thought of scientifically by production engineers, but a slight acquaintance with the marginal theory of economics shows that that is precisely what we are trying to apply in Work Study. This is particularly related to quality. The customer expects a certain degree of quality in the product he buys and with a given state of skill or techniques this can be objectively improved or maintained and at the same time profit margins can be increased by the application of Work Study in one way or the other. Or, again, by maintaining a given quality much improvement by Work Study techniques can reduce marginal costs and in consequence reduce the selling price and so increase sales.

There are a number of obvious ways by which reduction in scrap costs can be achieved by keeping a wary eye upon quality. For example, material handling adds nothing to the value of the product, but it frequently happens that additional increments in costs of this kind can avoid serious deterioration in the standard of quality. Reference to the illustrations (Figs. 1 and 2) of the pressboard containers clearly demonstrates this point. These containers are used for the storage and internal transport of components which are highly finished and made to a degree of precision. This is a marginal cost which is fully justified and has prevented losses by the maintenance of the necessary standard of quality. The fundamental principles of Work Study and its functions are well-known in industry. In my organisation we are

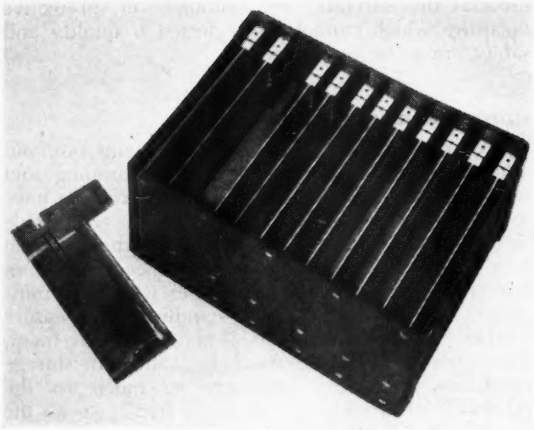


Fig. 1. Pressboard container.

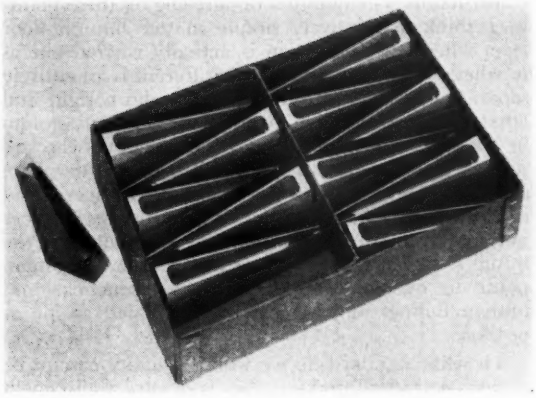


Fig. 2. Pressboard container.

applying the techniques in all departments, including Inspection, where in one instance that can be recalled, as a result of Work Studies we have recommended the purchasing of new inspection equipment, not only to speed the output but to improve the quality by elimination of human error and opinion. In addition, this activity is also instrumental in establishing time allowances of operations by objective analysis of observed facts and this is particularly valuable where conflicting opinions between interested parties could lead to disputes.

ratefixing

It must be appreciated that sound incentives are a part of, but in no way a substitute for, good management. In contrast their proper installation and maintenance requires a great deal of work by skilled managers, but the advantages more than repay the efforts. I know of no other management tool that will pay a higher rate of return on money invested, nor do I know of another tool that has the threefold advantage of increasing earnings, improving quality and productivity and reducing costs. Much has been written and said around this very controversial subject; there appears to be a reluctance to relinquish one of two points of view. Many hold the view that the rush to obtain profit inevitably leads to some sacrifice in the quality of the product; many again disagree and insist that it is possible to promote incentive rate of production and still maintain the desired quality standard. A great deal depends on how one looks at the problem.

Production engineering is not as crude and as simple today as compared to the "old days". Engineering progress and commercial competition allied to new techniques of processing, plus progressive uplifting in the standard of education, cultivate completely new lines of approach. The title "Ratefixing" is in itself inadequate, old-fashioned and not truly descriptive of the duties and obligations of the Ratefixing Department. Too many of the traditional shortcomings are still being related to the title, although modern practices have eliminated most of these deficiencies. It may be that we should coin other true and more descriptive titles. The new régime growing up within industry is for Work Study to carry out the function of integrating this activity and its relations with the other factors of production, according to the relative importance of those factors. "Production Costs and Methods Engineer" may be a more true and descriptive title for the present Ratefixing Department and then perhaps some of the traditional derogatory comparisons will disappear. It is not new to talk about quality and costs; in the modern concept of production engineering these are rightly highlighted as the inseparables. To achieve both we must maintain quality; we must also produce to realistic costs or we will not gain new markets in order to inspire greater production.

Emphasis will always be placed on the best possible quality at the best possible cost and the two must go hand in hand; these cannot be separated. The Rate fixing Department has a very real responsibility to ensure that the standards of quality are met in incentive schemes; they consider the standard of quality desired and allow time accordingly. The producer is not paid any profit he has gained in time until the Inspection Department have accepted and approved the quality as an *independent issue;* therefore the producer must maintain the quality of the standard even though he increases his output.

aircraft inspection techniques

The human element side of inspection is probably the most indeterminable factor that the planning engineer has to contend with when raising his method and getting agreement from Inspection on the points he wishes to cover during the course of

construction. The question of agreeing on these points is, I think, a relatively simple matter but on floor level where the inspection is actually carried out as to whether it is good, poor or indifferent is an entirely separate matter. The question as to who is right and what standard the component has eventually got to be passed is the prerogative of Inspection, who are subjected to the human feelings of people with whom they deal. This is a point which must not be overlooked in the whole field of quality control, because it does not matter how much equipment you put into the initial stages of the job to ensure accuracy, the main point to overcome is the physical, practical and human failings which must be eliminated as far as possible.

To what standard do we work? Quality cannot be inspected into a product; this is a very well-known phrase and still stands. It is sometimes suggested that Inspection create a standard to which the production departments have to work. This, of course, is quite wrong, as it is not the object of the Inspection Department to ensure perfection. Furthermore as they do not carry out productive work, it cannot be said that they create quality, but rather that their aim is to achieve the highest possible standard consistent with design requirements. The modern attitude towards inspection is that inspection processes should be regarded as an integral part of the cycle of manufacture, and just as much forethought and planning should be devoted to them as any of the productive operations themselves. Results of this attitude are reflected in the fact that there is a remarkable selection of mechanical and automatic inspection devices now available that eliminate the human element and generally speed up and improve inspection. However, the application of the principles of method study has resulted in the development of inspection techniques that keep pace with the most rapid production processes.

protective measures

I opened by saying that aviation is terribly unforgiving of carelessness, incapacity or neglect. Failure can, and has, meant the loss of hundreds of lives. There is also the financial aspect, as there may be several million pounds invested in the aircraft. One can recall the jet disaster where they found that the structure would not stand up to pressure at high altitudes. This could result from fatigue crack propagation initiated by a scratch. If this is to be prevented adequate protective measures must be taken during all stages of production.

At the forming stage extensive precautions are taken to ensure that the sheet is protected, and swarf and other foreign matter is kept to a minimum so that scratches and ordinary manufacturing tool marks are eliminated. Again, at the final assembly stages, there is a high risk of scratching, and at this late stage scrapping can be extremely expensive. The use of sprayed-on plastic coating, floor boards to cover those parts of the wing on which work has to be carried out and the padding of shop equipment used around the aircraft are examples of protective measures which cannot be neglected if quality and safety are to be maintained.

stores and material handling

Most engineers are aware of the problems, both old and new, that we have to face in handling and storage of raw materials and finished parts. We have so far only disturbed the surface of the very wide field of research which we must cover in this direction in the future. Much emphasis has been placed in numerous Papers on the techniques which we must adopt to eliminate manual handling and ensure "safety" from damage in all stages of movement. Very little has been said about the inadequate storage conditions that can contribute so much to the efficiency of achieving "damage free" stock, the importance of efficient layout, adequate binning, scrupulously clean areas and how complete realisation of the responsibilities of storekeepers — which is sometimes so lacking —will contribute to quality. Many organisations, I am sure, do not place sufficient importance on the selection of stores personnel who, in the new era of expensive components, will be required to operate to higher standards of handling and understanding of special storage requirements. A watching brief is at all times maintained by Inspection in the stores by periodical checks, but I am sure most of this would not be necessary if the class of storekeeper was raised to a higher level. Quality is everybody's business.

outside supplies

It would be very wrong not to say a few words about the problems of outside supplies. I have already suggested that we are subjected to alternating booms and slumps in this industry, and because of these unstable conditions we do not always consider it economical to lay down sufficient plant to cover the whole of the job. For these reasons we resort to subcontracting.

Apart from specialist suppliers of proprietary parts there may be thousands of different parts subcontracted to our own design. These suppliers are also subjected to the same short time cycle, small batch and design change problems as our own factory which I have already covered. For this reason our relations with them go beyond the more commercial relationship which usually exists in this type of contract. At one stage, a Suppliers Conference was held so that the mutual problems could be discussed. The greatest danger that we have to face when dealing with this type of situation is the fact that due to the time cycle injected into such contracts, invariably if rectification is needed on receipt of deliveries there is an extreme reluctance on the part of the main contractor to despatch back to the supplier. This can lead to the very insidious position of small subcontractors producing inferior goods with the knowledge of this sort of situation. I would like to see much more surveillance of quality at these small contractors, with a more strict control over their

(*concluded on page* 495)

AN IDEOLOGICAL CONFLICT

between

WAGE RESTRAINT AND INDUSTRIAL ENGINEERING

and its effect on productivity

A Thesis by B. ABHYANKAR, A.M.I.Prod.E.

FOREWORD

Industrial engineers usually choose to remain silent on the subject of wage arbitration, although this stakes out a big field for research.

Taylor and the Gilbreths gave impetus to the study of Time and Motion Economy, Personnel Psychology, Occupational Therapy and Human Engineering. These were all intended to contribute towards "Scientific Management", but it seems that each study resulted in detours. It is expected that this work will focus some attention on relating all of them to the parent purpose.

No theory is ever fully accepted by all and this work, because of its speculative rather than experimental trends, is perhaps more open to criticism than many. "A theory is never overthrown by facts but by another theory", says the President of Harvard University. Should this Paper be "overthrown", therefore, the science will automatically have advanced.

In order to avoid misunderstanding due to oversimplification, suggestions and recommendations are omitted.

PREPOSITIONS

1. That a lack of co-ordination exists between the actions of the arbitrators of wages and industrial engineers in respect of setting wage standards.
2. That this state of affairs is a product of conflicting ideologies and the growth in isolation of the three institutions — industrial engineering, industrial economics and wage arbitration.
3. That this discord results in the nullification of gains in productivity through incentive bonus schemes.
4. That industrial engineers are forced to yield to pressure of circumstances and deviate from their own theories, and thereby cause inter-industry variations in standards.

PROLOGUE

Industrial engineers, arbitrators of wages and industrial economists share an interest in the functioning of the economic system. This equality, however, is not maintained in respect of their relative placing from the centre of national events or a hand in their control :

(i) Industrial engineers work in an advisory capacity and express opinions when called upon. Their work is concerned with the practical problems of a rational wage structure and wage incentive.

(ii) Wage arbitrators are a supreme body with real —though delegated—powers resting with each member. Their primary concern is sectional and restricted to an aspect of employee/ employer relations.

(iii) Industrial economists control the direction of executive decisions with the help of proved economic theories and/or trends. Their theories are, however, restricted to the field of theoretical inter-relationship involved in the distribution of national incomes.

Although all three draw freely on the resources of the others, there is neither any temptation, nor compulsion, for co-ordination in their efforts.

Some arbitrators of wage rates freely draw on a portion of the job evaluation theory — industrial engineers' work — by quoting factors like the "responsibility" or "hazards" of a given job classification to justify a claim. On the other side, some put forward "capital costs" or "national costs" theories — industrial economists' theories — to oppose the same claim. Neither side usually calls in the industrial engineers and/or economists to evaluate the claims on scientific, or at least systematic, theories of job evaluation, etc., and agree to abide by them. The decision so taken in isolation by the fragmentary use of the theories of others automatically becomes binding on the industrial engineers.

LIMITATIONS

1. The investigation will be restricted to the political boundaries of the British Isles due to the pecuniary circumstances, such as place in world economic sphere, social institutions, etc.
2. The investigations will be restricted to the manufacturing industries in order to limit the variations in set circumstances.

(1) investigations into practices and theories

Parallel with the other changes in the social behaviour of man, arbitration is only a link in an unbroken chain of events. History of the present arbitration machinery is hardly 40 years old [1]; the practice of arbitration is much older [2]. A showdown forced by the workers or the employer over any specific issue has almost always ended in a negotiated agreement. Experience shows that these agreements do not go beyond "patching things up" for a period. "British Labour Relations" says a 1939 Broadsheet, "have developed largely by unplanned and often unconscious process" [3]. The development of joint consultative bodies to deal with employer/employee disputes depict the basic assumptions that :-

(a) the disputes are caused by the employee/employer demands of the other side;

(b) they are exclusive of the two sides of an industry and should be settled between themselves; and

(c) they will continue to occur from time to time, and a body permanently available would reduce the delays in procedure and thereby minimise the losses to both sides.

Due to the progress of man in his outlook towards life, the development of various schools of thought, economic expansion of the world, better and more facilities for obtaining information and education and many other reasons, the causes for disputes have progressively increased. These reasons, for the period 1918 - 50, are placed by Gitlow in the following order of frequency [4] :-

(i) wages (slightly over 50%);
(ii) hours of work;
(iii) discrimination against union members;
(iv) working conditions, right of collective bargaining and overtime;
(v) employment of women;
(vi) equal pay for equal work.

By the acceptance in principle of both collective bargaining and non-discrimination, the present arbitration machinery has removed two of the causes for disputes listed above. Wages, hours of work and overtime are two sides of the same coin and, as such, they could be grouped under the heading "Economic Claims". Likewise, working conditions, employment of women and equal pay could be grouped under "Social Demands". Although social demands are put forward and dealt with separately, in the majority of cases — if not all — they have economic gains attached [5]. The so-called social demands must also, therefore, be treated as economic claims for this work.

Whitley Councils were set up in a period when "industrial engineering" as it is known today, was very much in its infancy [6]. Time study, methods study and motion study engineers — work study engineers as they are known collectively today — were part of the management team operating in a very restricted field [7]. The question of their influence in the field covered by arbitration — such as changes in gross wages, pace of work, skill required, etc., etc. — did not arise at the time. It seems that the recent appointment of the "Cohen Council on Prices, Productivity and Incomes" is the first official acknowledgment of this relationship.

The activities of industrial economists, on the other hand, cover yet another field not touched by either the Whitley Councils or industrial engineers. There are many ways of collecting and interpreting the statistical data on which these activities depend. One aspect where none of their methods deviates, however, is that they work on the marginal productivity of an economy [8].

The basic issue, therefore, raises three questions :-

(a) What are the causes of economic demands?
(b) Is arbitration an ideal way of dealing with the disputes?
(c) If so, are the tribunals impartial and representative of all concerned in the disputes? If not, do they have to be impartial and representative?

The inter-relationship of wage arbitration and incentive is dependent upon the answers to those questions.

(2) case for labour

The labour demands in post-War years [9] cover three distinct fields :-

(a) to compensate a reduction in buying power;
(b) to increase buying power; and
(c) to claim a bigger share of industrial incomes.

The first (a) is aimed at an adjustment of buying power to rises in the cost of living — an action engendered by self-preservation. Had the standard of living been static, and definable as such, a smaller number of demands on this account would have developed into disputes. Unfortunately, history proves that the luxuries of the last decade are the necessities of this. Labour tries to decrease the period of transformation of luxuries into necessities, and disputes therefore become inevitable. Ross calls this a competition for purchasing power.

Ross further clarified this [10] : " When adjustments in costs take place rather generally, the very process of decreasing production to increase profits will bring about changes in income that require smaller and smaller values of the production rate maximising income. Thus a shrinkage in national income can bring about an appearance of general over-production. A further reduction in employment in capital goods industries follows ". This statement explains the reason for the repetition, at intervals, of labour demands.

Demands under (b) are based on the theory that, given steady employment, productivity and prices become compensatory factors. Efforts to preserve full employment, and through this to create an abundance of goods in the market, will achieve the same ends, namely higher wages or higher values for the same wages.

Arguments in justification of demands under (c) were put forward as long ago as 1892 by Gompers [11] and they are often repeated in this country by many labour leaders — or their own versions are stated [12]. Gompers declared " One of the greatest causes of (this) stagnation — if not the greatest — was undoubtedly the fact that the productive power of the workers progressed at a greater ratio than their ability — or rather their opportunity — to consume. In other words, there exists in our economic system the evil sometimes called " over-production "; for, were the consumptive powers of the workers to keep better pace with their productive ability, the anomalies of a people going a-hunger with ever recurring industrial, commercial and financial panics, crises, and stagnation — in the midst of plenty — would be unknown ".

About the same time, Gompers coined the slogan : " It is better to resist and lose than not to resist at all ", and Shaw wrote [13] : " The business of a labour man is not to suffer, but to make other people suffer until they make him reasonably comfortable ".

The tendency in recent years has been to effect a steady increase in the standard of living of the workers by gaining a bigger share of industrial profits. All technological developments result in an increase in output per man-hour, it is claimed. If this in turn is not to end in a reduction of the labour force, the industry has either to produce more of the present commodities or produce new commodities to utilise the surplus labour. Although the claims for bigger shares of industrial incomes are new, comparatively, they are based on an old theory. Ricardo said in 1818 [14] " Profits depend on wages. There is no other way of keeping profits up but by keeping wages down." This theory has since been developed in two directions — the development of Marx's theory, and the theory propagated by A.F. of L. in the U.S.A. and broadly followed by the T.U.C.[15].

(3) case for management

The ownership of industry is rapidly changing hands from individuals to corporate bodies, as a result of which the provision of funds to run an industry is no longer synonymous with management but has become a separate function. Banking and finance have become separate subjects for specialist studies, as has industrial administration. " It is not the benevolence of the butcher, the brewer and of the baker that we expect our dinner " says Mills [16], describing Adam Smith's Law of Self-interest. In the light of this statement it is to be realised that self-interest of a financier, or financing body, does not necessarily coincide with that of management in industry.

In industry it is the management who employ, and it falls upon the management to accept, reject or compromise demands made on an industry irrespective of their origin — trade union, share holder, banker or the State. Of these, State demands are unavoidable for taxation policies are based on the balance of payments of the economy, and any case for relief is only arguable on the basis of the collective position of like industries. It proves futile for individual establishments to expect any deviation in the pattern of taxes set nationally. Although the productivity of individual establishments changes the national average, the reverse is not true. Should, therefore, any relief be given on a national basis, its advantages vary amongst individual establishments. (See Fig. 1.)

Capital and raw materials are as vital to industry as labour, though in varying proportions. The quantities of raw materials required are relatively fixed, but as producers of raw materials are subject to occasional labour and other demands, prices of raw materials become quite flexible. To ensure the continuity of production, managements have to resort to inventories. In times of rising prices, inventories offer the best avenues of profits. Falling prices, however, bring about losses and managements have no option but to take those risks.

One consequence of segregation of finance from management is that the traditional rôle of profits no more rests with the management [17]. This introduces a new element in the management function, for the confidence of management in indirect and ultimate benefits is not necessarily shared by financiers in decisions regarding the availability of additional capital. The unionisation of labour, and corporate ownership of industry, has changed moral and social behaviour in mutual dealings. " A sharp distinction

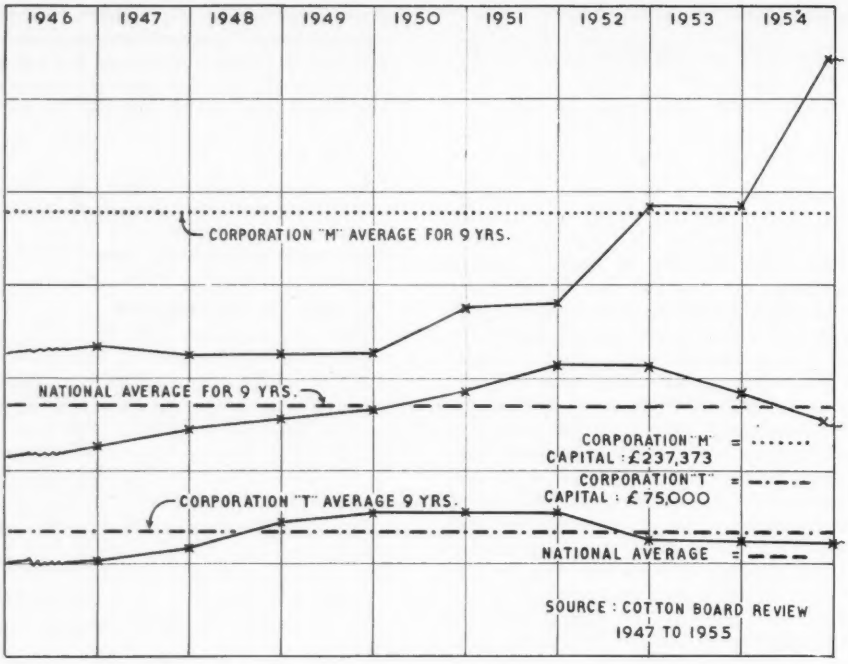


Fig. 1.

must be drawn between the moral and social behaviour of individuals and social groups", argues Niebuhr [18]. "This distinction justifies and necessitates policies which a purely individualistic ethic must always find embarrassing." There is no set pattern of entrepreneur activity [19].

In an endeavour to procure the necessities (capital, labour and raw materials) management have to resort to substitution wherever possible. The substitution of capital by labour is rare — if not impossible — in this country on a national level, and is likely to remain so under "full employment" [20].

The substitution of labour by capital, however, has enormous possibilities and the process is found to be paying a dividend [21]. Although the behaviour of capital and labour has many similarities — such as bargaining on the basis of available alternatives, etc. — there is a great difference in their usage. Additional capital enables industry to reduce unit costs — increase marginal productivity — and, in the equation of exchange, their costs remain a stable element irrespective of any changes in actual production. Labour, on the other hand, in substitution of additional capital, increases unit labour costs progressively with the rate of production and varies with the rate of production. Should production be kept constant, additional capital helps to reduce unit labour costs in an inverse ratio to capital availability The management therefore reduce risks of unpredictability by the substitution of labour.

Of the technologically and industrially advanced nations, Great Britain is perhaps the most dependent on imported raw materials, as a result of which, on the one hand, she has to export more to pay for these imports and, on the other hand, she has to face the risks of shortages and unstable prices. The substitution of raw materials by labour is possible only in a very narrow field [22]. If money is made available for research and the subsequent manufacture of synthetic raw materials, however, these can replace natural raw materials successfully. The availability of capital depends on the returns offered, and returns cannot be visualised or computed unless research is complete. The management has therefore to finance research from trading funds.

The majority of export markets operate on a competitive prize system. The mechanism of such markets controls general as well as specific wages. Because the consumer demand and supply position determines the market price position, cost relative to price determines the profitability. Profitability determines the level of output which, in turn, determines employment. Obviously, the continuance of industrial activity, and therefore the employment of workers, depends upon competitive pricing. Management prefers any increase in productivity to go to the consumer and to capital formation, so that the gains are distributed throughout the economy and inequities in buying power amongst section of the community are avoided.

Management does not consider a rise in the direct wage rate a correct way of compensating for a loss in its buying power, because the demands and rises in wages are inconsistent throughout the economy [23].

(4) case for the industrial engineer

Industrial engineering is a new name [24] for a science which had its origin contemporarily with the beginning of the Industrial Revolution [25]. The aim of industrial engineering — synonym, scientific management — is to maximise productivity [26]. The controls devised by industrial engineers in pursuance of this objective only apply to the supply side of the product market. In general, their contribution towards a better industrial structure is appreciated, though their efforts are often thwarted by economic problems such as unemployment. If analyses made available from time to time by the economists are accepted, there appear to be three causes for unemployment :-

(i) depressional;
(ii) frictional; and
(iii) seasonal.

In order to minimise the effects of unemployment, industrial engineers have sought to bring their techniques to bear upon these larger economic problems. Although their efforts succeed in the seasonal and frictional fields by the use of techniques such as inventory control, production scheduling, payment by results schemes, plant layout study, etc., unemployment caused by depressions still remains a major obstacle [27].

Planning the firm and industry for optimum size by rationalisation and integration has no alternative in the eyes of an industrial engineer [28]. The elaborate production planning so devised and executed on rational lines, however, breaks down in the market because of price mechanism and other reasons, such as changes in customer preference. In the field of material utilisation, schemes devised on a scientific and rational basis break down owing to price mechanism allocating resources in a different way. Consumer sovereignty and purchasing power do not necessarily operate in line with rational materials utility and equitable distribution of national incomes. Thus the marginal analyses of economists dominate the policies and replace the rational objectives by variables such as "politics" and "self-interest".

The problems that industrial engineers have to contend with are economic. Knowles summarised these as follows [29] :-

1. how to shift the cost of destruction of craftsman's skill to those who benefit from progress;
2. how to assist displaced workers over a period of unemployment resulting from greater output;
3. how justly to divide the savings resulting from greater output;
4. how to place a fair value on a worker's invention;
5. how to interest craft unions in efficiency when the demand curve for their services is inelastic;
6. how to gain worker efficiency in industries which restrict output for monopoly profits;
7. how to relate wage administration techniques to the general wage level;
8. how to evaluate labour's subjective opinion of the worth of jobs;
9. how to ensure continued full employment so that insecurity will not cause restriction of output;
10. how to achieve economic stability when some degree of consumer sovereignty and freedom of economic organisation remain.

It is apparent that none of these problems is created by industrial engineering practices (although perhaps they are brought to light by them) and condemning the industrial engineer or his techniques will not solve any of them.

Resources allocation and production policies are engendered by theories of economists and politicians and imply an assumption that labour has an absolute value. It is not found practicable, however, to extend this belief in industrial planning. Lenin gave his endorsement to the production planning policy of the Russian economy on such an assumption which was logically perceived. It was hoped that neither depression, nor cartels, would limit output. Variations in worker incentives were found to hamper the programme and make it highly flexible [30]. The replacement of free Trades Unions by "Stakhanovite" workers did not improve the position, and the problem of worker incentive still remains the deciding factor in Russian production. This endorses the need for gaining the consent of the various economic groups in society. The concept of political democracy and the approval of organised groups is a part of industrial engineering technique and, to this extent, the industrial engineer agrees with the settlement of wage disputes through arbitration.

Assuming other factors to be constant, even a slight increase in wage rates without a compensatory rise in the individual productivity of the workers concerned is bound to result in an increase in production costs. In resisting smaller increases in wage rates on the grounds of costs, however, the managements seem to assume that :-

(a) every increase in the wage rate is to be reflected in prices;

(b) every rise in prices directly affects demand; and

(c) fluctuations in demand only affect managements.

These assumptions depict a lack of appreciation of "The Theory of Elasticity" propagated by Marshall [31]. The Theory of Elasticity apart, one has to accept that changes in commodity prices have a direct effect on the buying power of an economy. It would, however, be incorrect to assume that demand changes in direct relationship with prices,

or that changes in demand so caused are restricted to the specific commodity undergoing a change [32].

In the early stages of industrial development, wage negotiations were carried out between occupational groups — miners, engineers, etc., — and an undertaking, or representatives of similar undertakings. The membership of occupational groups — guilds, trades unions, etc. — was based on the possession of definite skills, experience and occupational pride. Within their own groups, workers were conversant with almost all work. Their grading and control was simply a matter of seniority, leadership and an addition to the basic common skill and knowledge of the group [33]. The highest possible quality work was automatically expected of each craftsman and the time required to complete a piece of work was subordinate to quality and, in any event, the decision as to the time required rested with the worker. Diversity in the requirements of skill within a group has been created in recent years to such an extent that it is no longer possible to group a number of workers in an occupationally broad grouping for a package deal on wage rates [34]. Negotiations of wage rates on broader occupational groupings, e.g., engineers, miners, etc., are therefore not consistent with the need of the day.

Modern management does not leave the quality judgment to the workers or to their foreman; it is dictated by the planners and is based on functional consideration [35]. Conformance to quality is checked by special staff operating independently. Likewise, the motions of machine and man are carefully studied, balanced if necessary, and a detailed method handed down for strict conformance. In an industry, the capital costs increase with mechanisation, and costs per unit of output depend upon the rate of production which, in turn, depends upon the operative effort. It is, therefore, not the skill, quality and discretion or judgment, but the operative effort — a product of time and the amount of work — that the wages purchase. The industrial engineering technique of "Time Study" comes into play at this stage.

Democracy has no part to play in purely scientific fields such as matter, space and time. Both sides of industry accept this in principle to apply to actual time study readings — the actual elapsed time before normalising. Maintenance of the pace of work, however, depends upon the physical ability, and also stamina, of the worker, and these, in turn, depend upon the worker's mental attitude to his work [36]. Mental attitude to work is a product of the socio/political conditions of the worker and is, therefore, clearly beyond the scope of industrial engineering practices. The variations caused in the pace of work as a result of changes in mental attitude seem to be often underestimated by both sides of industry. An industrial engineer should be able to assume the mental attitude to work to be reasonably satisfactory as a result of industrial relations activity in a given establishment, in which case the normal compensatory allowances given by the industrial engineering practices — such as fatigue, personal needs, etc. — should be acceptable to all concerned.

PRINCIPAL FACTORS WHICH BEAR UPON THE DETERMINATION OF WAGE AND SALARY RATES.

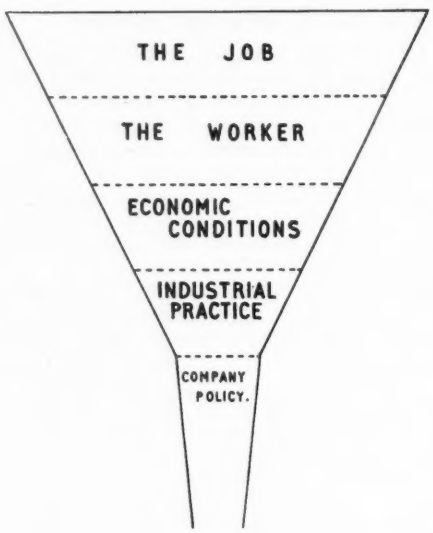


Fig. 2A.

It is noticed that nearly 60% of British production comes from smaller establishments [37]. Although many such establishments employ "Personnel Management Staff", under various titles, e.g., Labour Officer, their activities cover only a part of industrial relations duties [38], and the vital task of creating the desired mental conditions is completely neglected. It is, therefore, to be expected that repercussions of national socio/political events directly affect the mental conditions of workers. Although the use of industrial engineering in its broad sense [39] is restricted to larger establishments, one of its techniques — the incentive scheme — is used in one form or another in almost all establishments throughout this economy. The task of creating the correct mental attitude towards maximum productivity is thus confused with the purpose of compensatory allowances in time standards. The incentive rates thus become a bargainable item in such establishments.

In larger establishments, where industrial engineering is practised on a broader basis, techniques like job evaluation are used to remove wage inequities. Rationalisation of the wage structure by the establishment of a logical relationship of wages to the nature of the job and the inter-relationship of jobs, is found effective in creating a correct mental attitude towards work. In establishments where such adjustment has been carried out, neither basic time study nor the rate of allowances present any problems [40]. The limitations imposed by bilateral agreements of minimum rates of wages for an occupational group, however, restrict the scope of these adjustments to

METHOD OF DETERMINING WAGES RATES

(OTHER THAN BY TIME & MOTION STUDY)

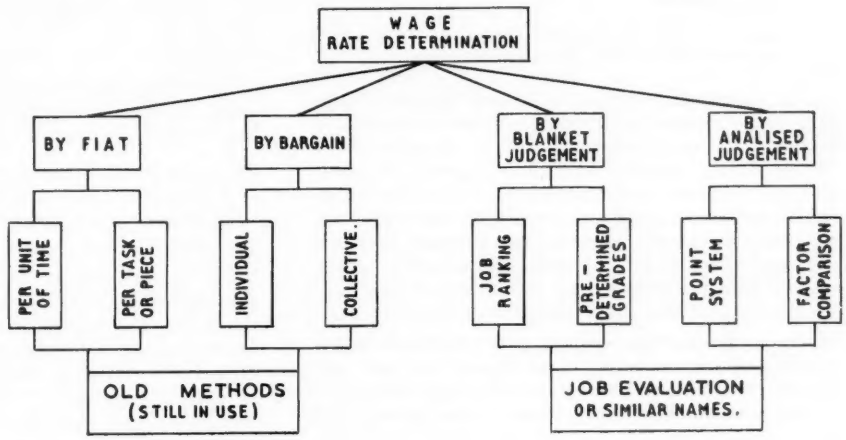


Fig. 2B.

up-grading. The up-grading so executed creates additional inequities amongst similar jobs in smaller and larger employment units.

Under the present system of wage arbitration, a case is made for an individual occupational group whereas, in reality, a degree of satisfaction is derived by a comparative wage rate — perhaps this stems from the pride of profession. An industrial engineer bases his judgment of wage rates on five factors (Fig. 2) and considers it necessary that the value of each of these five factors should be determined purely on its comparative importance. The success of such rationalisation, however, depends upon the formation of a structure of wages that will cover all jobs. If conditions of the labour market were ideal in the sense that labour mobility was not hampered by the lack of facilities or information, and was free from underemployment and conspiracy, this wage structure should automatically evolve under full employment. It is even argued that "The job evaluation process is less expensive than the operation of a free market in adjusting wage rates" 41.

"Annual improvement factor wage increases" have been in operation in some American industries since 1951 and a similar arrangement is being debated at Westminster. Backman has, however, shown that this "spells trouble on the economic front" 42 due to many factors, such as diverse pressures, to which individual industries are subjected. It should be noted, further, that the purpose of the annual improvement factor is "to assure an ever-improving standard of living" 43 to hourly paid workers and is payable "in addition to the changes in wages based upon changes in consumer prices" 44. The introduction of such an element in Great Britain is, therefore, not likely either to eliminate the annual round of wage claims or in any way contribute towards better industrial relations.

"As pioneers, our forefathers made all possible mistakes due to their complete ignorance of each branch of industrial organisation, of finance. As believers in free enterprise, some of them also made every possible error that natural greed could run them into" 45.

All this has left a legacy of mistrust in industrial relations. The difficulties discussed here are not confined to British industry and it is not industrial engineering activity alone that faces them. It was hoped that by free discussion "worker participation" would overcome the suspicions. Experience proves, however, that "The phrase is being used here as if it were some psychological abracadabra" 46.

The class-consciousness of the British worker is peculiarly his own. By and large he does not emotionally accept the free enterprise system as does his counterpart in the U.S.A. The British worker sees himself always as a member of a group. "While the American youth believes that he can eventually reach a life of luxury and leisure if he works hard enough now, the British youth believes he can never reach it unless he becomes a wide boy or wins it on the Pools" 47. The problem of communication adds to this strain: "Old friend at West India Dock has as much chance of hearing Mr. Cousins in person as a soap boiler in Dublin has of seeing Lord Heyworth in person, possibly less", says Chisholm 48. In short, the British worker abides by group decisions made for him, although he may at times disagree.

An industrial engineer relates all these problems to two basic causes :-

(a) a conflict in the principles governing the distribution of national incomes on the basis of split pound values;

(b) defective and inadequate system of internal and external communications in industry.

" In historical perspective ", says Walker, " progress is not an inevitable feature of human existence, nor even a natural aspiration " 49. In short, we have moved from " established " to " adaptive " society, and it is necessary to remove artificially any inequities caused by either ignorance or greed. The industrial engineer, therefore, considers the primary function of wage arbitrators to be the rationalisation of the wage structure rather than the bringing about of specific and/or individual changes in wage rates.

Assuming the skill, mental and physical requirements and responsibility to be equal amongst, say, dockers, market porters and miners, wage arbitrators would place dockers higher than market porters but lower than miners when judging working conditions. In such an eventuality, actual wage differentials will depend upon (a) the industry and (b) the individual variations in conditions of work and environment (Fig. 3). Under this system, due to the two-way limits imposed by arbitration, an employee is safeguarded against undercutting and an employer is safeguarded against excessive demands.

Such a practice will check the wage price spiral caused either by conspiracy or monopoly and help the nation as a whole to place equitable values on each occupation. It will also help to predict well in advance any changes in the occupational groups by slow deterioration and/or changes in work contents without adjustments in earnings 50.

Fig. 3.

Industrial engineering deals with productivity, which is equated by the British Institute of Management as

$$\text{PRODUCTIVITY} = \frac{\text{Output}}{\text{Input of material, plant and labour}}$$

If material, plant and labour be assumed to be relatively stable, their proportional values will change once a year, or more frequently, due to :-

(a) changes in demand;
(b) changes in wage rates; and
(c) changes in the costs and availability of materials.

In smaller units of production — which are responsible for 50% or more of the national production — the scope of industrial engineering activity is usually restricted to three of the six basic elements 51. Of these three, " Efficiency of plant and equipment employed " depends finally upon sales and production control functions 52. In the " volume, continuity and uniformity of production " field, success partly depends upon sales, production policies and material availability, and even the most successfu' industrial engineer could not do much in the absence of reciprocity. Finally, as elaborated, "speed" and " effort " in work measurements have become bargainable and, as such, the industrial engineer is forced to deviate from his theories and "compromise" and " arbitrate " each of his actions.

(5) summary and conclusions

Faced with the ever-increasing demand for capital for the manufacturing industry and competition from non-manufacturing activity, the position of an industrial economist is far from being an enviable one. He avoids publicity and, by tradition, he keeps aloof, expressing opinions only when specific questions are asked. Though dealing with the manufacturing industry, his sources of information, theories and, to a considerable extent, even his training belong to the world of finance — a remote and isolated activity.

The industrial engineer's rôle in an industry is modest since he only acts in an advisory capacity, leaving decisions to the executive. To a considerable extent he acts as an interpreter of the views of each side in employee/employer conflicts and his impartiality is therefore vital.

Acceptance of the present form of arbitration in itself perpetuates the two divisions in an industry. Only those portions of the industrial engineer's measures which are actually favourable or unfavourable to one side or the other are brought forward at arbitrations — not a very amicable field to begin with. Some of these measures, therefore, get rejected without further consideration due either to lack of understanding or simply a fear of change.

A comparison of the actions of industrial engineers and industrial economists is not justifiable, on the grounds that one bases his actions on marginal considerations whilst the other bases his on specific

circumstances. They almost express the difference between precision and casual observation.

Wage arbitrators officially represent groups with diverse interests and though neither can be accused of misrepresentation, they only bring forward those points favourable to their own case.

The bases of thought and action in each of the three cases being fundamentally different, they have resulted in the development of separate institutions, traditions and methods of training and recruitment. To this extent, each could be suffering from an occupational introversion.

The nullification of gains in productivity is calculable both at plant level and at national level. Let it be assumed that two identical production units — say "Alpha" and "Beta" — are available for comparison. One — "Alpha" — is under the control of a large enterprise, and the other — "Beta" — in a smaller employment unit. Let the M.T.A. standards be :-

E.B.Q.	100 parts.
Wage rate/grade	3s. 0d. per hour.
Overheads and Supervision 50%	100% of direct labour
Plant and Maintenance 50%	
Labour time allowed ...	2.5 man hours per piece.
Cost of materials	1s. 0d. per piece.

To grade labour at "Alpha" to perform the task per standard an addition to the wage rate of, say, 10% becomes necessary [53]. The labour rate in "Beta" already equals the standard, but the time allowed needs adjustment[54] — say a 10% rise.

The results can be expressed mathematically :-

M.T.A. STANDARD

$$\frac{(\text{Quality} \times \text{time} \times \text{rate} \times 2 \text{ for overheads, etc.}) + \text{Material}}{100} = \text{Cost per piece.}$$

$$\frac{(100 \times 2.5 \times 3 \times 2) + 100}{100} = 16 \text{ shillings per piece.}$$

(a) PRODUCTION UNIT "ALPHA"

$$\frac{(100 \times 2.5 \times 3.1 \times 2) + 100}{100} = \begin{array}{c}16.50 \text{ shillings p.p.} \\ \text{or} \\ +0.50 \text{ shillings p.p.}\end{array}$$

(b) PRODUCTION UNIT "BETA"

$$\frac{(100 \times 2.75 \times 3 \times 2) + 100}{100} = \begin{array}{c}17.50 \text{ shillings p.p.} \\ \text{or} \\ +1.50 \text{ shillings p.p.}\end{array}$$

Two observations may be recorded here :-

(i) In spite of M.T.A. having included reasonable allowances in the time factor, whether graded workers are used or workers "as they come", the production costs are greater than M.T.A. assessments.

(ii) In practice, the range of variations is like'y to be greater due to external factors such as the standard of the industrial engineer engaged, machine utilisation efficiency, etc.

If the value of production in smaller units collectively and in bigger units collectively is assessed as equal [55], and the 10% variation in the hypothesis is accepted, the national productivity will have to increase by $\frac{(0.50 + 1.5)}{2} \times \frac{100}{16} = 6.25\%$ a year before any rise in national productivity is shown. A desire to "keep the peace" between the two sides, ignorance, lack of force of conviction and many factors influence many industrial engineers to adjust their estimates to suit the actual costs in order to show results of his work; in other words, he yields to the pressure of circumstances. The real range is thus concealed at plant level. Since no such concealment is possible on a national level, the variations express themselves in dividends and/or "take away" wages. Two points are relevant, though not directly connected with this Thesis :-

(i) Industrial engineering as a profession is exposed to much misunderstanding — perhaps due to the infiltration of sub-standard talent, lack of compulsory registration and/or control through ethical code [56].

(ii) Almost all the industrial engineering theories and experiments have evolved through private sponsorship in this country [57]. Although they may, in fact, be fair and just to all the sides involved, an official seal of impartiality which the State and/or an academic body — such as the University — automatically provide, is felt to be lacking.

In conclusion it is claimed that all the four prepositions are proved [58].

CONCLUSIONS

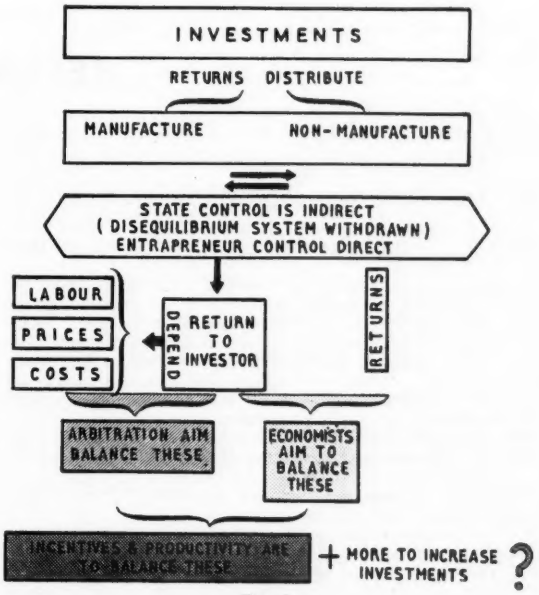


Fig. 4.

POST SCRIPTUM

One cannot get to the core of a problem by taking a cross section of it, at any one stage. The problems of incentive in industry are the problems of industrial relations, and in this country they have an unbroken history. An historical process can be understood only by surveying its growth and grasping the inner meaning of each of its developments. In historical perspective, problems of industrial relations are the product of personal attitudes. An individual's attitude to his work depends upon the personal and the social life he leads and the two cannot be separated.

"THE SOCIAL INSTITUTIONS, ECONOMIC ARRANGEMENTS AND SCIENTIFIC BELIEFS ARE ALL BOUND TOGETHER BY CERTAIN IDEALS, BY WHICH MEN OVERCOME THE DUALISM OF THEIR NATURE, THE ANIMAL AND THE HUMAN, INSTINCT AND INTELLECT, INDIVIDUAL AND SOCIETY", argues Dr. Radhakrishnan 59. Lasting solutions are, therefore, to be found only in the upliftment of ideals in the social institutions and their philosophies of life, to a level beyond class distinction — or party or group distinction like the "employer" and "employee". In recent years, some beneficial cross-fertilisation of ideas has taken place amongst employee and employer groups 60.

A study in ownership of industry in recent years reveals that the public companies own more than the unincorporated industries, partnerships and sole proprietorships put together 61. Thus, a majority of "employers" are "employees" of shareholders, some of whom may well be working for the enterprise managed by them 62.

An increase in the collective income of the employees that exceeds the contemplated needs of that community as a whole, will not only add to the demand of commodities but also provide a source of additional investment in industry — Wall Street have named this arrangement "consumer capitalism" 63. As long as any demand does not result in victimisation, valid arguments against it are improbable. Since man and societies alike are not immune from self-interest, a reliable way of proving or disproving victimisation has to be found. Since value of services — mental and/or physical — is not absolute but relative, it should be possible to evaluate comparative values for all occupational classifications. Although efforts in the past were mainly restricted to study and solution of the problems as they arose, there is no reason to believe that these studies are leading the economy towards a permanent solution. Study of a malady in itself could never lead one towards prevention; a study of normal conditions and deviations from these normal conditions is necessary for the purpose.

Research in two directions must precede such a work :-

(a) the completion of definitions, titles and codes for the occupational classifications used in economy;

(b) the completion of the existing comparative wage structure of the economy, based on the classification above.

On completion of such a study it becomes possible to evaluate comparative values of occupations on systematic — if not scientific — bases, such as "job evaluation" plans.

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2. Ian G. Shap, in "INDUSTRIAL CONCILIATION AND ARBITRATION IN GREAT BRITAIN" puts the historical beginning at 1824 - 25.
3. "PLANNING" by P.E.P., Vol. 151, dated 11th July, 1939.
4. Abraham L. Gitlow in "WAGE DETERMINATION UNDER NATIONAL BOARDS".
5. The author has seen identical toilet facilities, some marked "Ladies" and others marked "Women" in several plants. Whilst this differentiation has been resented, it has not caused any disputes. Lack of toilet facilities has, however, resulted in strikes, especially by men and women on piece-work.
6. A.S.M.E. terminology and definitions as published in the "Industrial Engineering Handbook", are adopted for this work.
7. A.S.M.E. have not included the term "Work Study Engineer" in their definitions.
8. In seeking advice from the economists, financiers are interested in the comparative returns they are likely to receive from their investments in the various industries and trades, and not in the income derived from a specific industry or establishment.
9. The demands in post-War years appear one-sided. The question of demands by management, even in disguises such as an increase in work-content without a compensatory rise in wages, is not included in this Paper as they are so rare and local in nature.
10. Dr. C. F. Ross in "DYNAMIC ECONOMICS".
11. Gompers in "Seventy Years of Life and Labour".
12. Two chapters are devoted to this subject by E. Shinwell in "The Britain I want".
13. Thomas Dunning quotes Shaw in "The Reminiscences".
14. Quoted by T. K. Kinloch in "Six Economists".
15. The March, 1599, issue of "Fortune Magazine", under the heading "What Labour Means by 'More'" by George Meany, President of A.F. of L. It did not take very long for labour in the automobile industry in the U.K. to raise the question of compensation for loss of employment for long service workers after General Motors in U.S.A. concluded such an agreement.
16. John Stuart Mills in "The Principles".
17. The traditional role of profits is considered to be: (i) incentive to face the risks of entrepreneurial activity; (ii) investments and capital formation; (iii) the key to resources allocation; and (iv) a spur to improved efficiency.
18. Reinhold Niebuhr in "Moral Man and Immoral Society".

19. Arguments put forward in justification of the appointment of part-time directors of the Bank of England prove this beyond any doubt.
20. Due to favourable costs, the greater part of the earth moving and material handling on the Damader Valley Dam project in India was carried out manually. On the Hoover Dam project in the U.S.A. undertaken by the same contractors, however, the work was mechanised, although capital for both equipment and labour was available on both projects. By the same token, components for duplicators, etc., are mechanically produced in the U.S.A. and sent to this country for assembly by hand and re-export to Canada.
21. In the automobile industry, general purpose machines were replaced by special purpose machines which, in turn, are being replaced by automatic machines such as transfer machines.
22. On one occasion, the author increased the unit labour cost to reduce material utilisation in the fish processing and packaging industry. In mass produced articles, such as radio sets, due to comparative costs it is often cheaper to replace a part than repair it.
23. In Australia, under a national agreement, increases to compensate rises in the cost of living are automatic throughout the economy. There is no such agreement in this country.
24. A.S.M.E. definitions as published in the "Industrial Engineering Handbook" (1956) are adopted in the absence of any national definitions.
25. In "Management's Debt to Engineers", Urwick argues this point convincingly.
26. The bases are best explained by F. W. Taylor in "The Principles of Scientific Management".
27. Demand for the product and price mechanism are clearly beyond the scope of industrial engineering.
28. The popularity of corporate ownership, and an increase in combines, are proof of this belief. In spite of greater outlay on items such as advertising, industrial relations, charities and scholarships, etc., combines and corporate bodies pay better dividends, even in industries on the decline, such as cotton. (Ref. Tattersall's "Annual Cotton Review".
29. "Industrial and Labour Relations Review" Vol. 5 No. 2. January, 1952, under the caption "Economics of Industrial Engineering" by Dr. William H. Knowles.
30. Barker argues this point in his publication: "Some Problems of Incentives in U.S.S.R. Industries".
31. Prof. A. C. Pigou in "Alfred Marshall and Current Thought" devotes a chapter to explaining this theory.
32. A substantial decrease of, say, 50% in bus fares may cause a proportional rise in the demand for suburban houses, but traffic in buses will not increase in the same proportion. Places of entertainment may benefit because of a decrease in the cost of travelling but the demand for a shorter week to compensate travelling time may create a problem for all industries. Conversely, an increase of, say, 50% in the price of bread may not decrease the demand for bread to the same extent.
33. For instance, the manager of a coal-mine was a miner with a knowledge of surveying, safety, shot firing, etc., the fireman — mining foreman — was a miner with the quality of leadership, etc.; even a dataller — mine labourer — had a knowledge of seam work, packing, etc.
34. It would make an interesting study to find out how many so called "skilled" engineers know what a slide rule is for, as against those whose work actually calls for mathematical calculations beyond "log" for accuracy.
35. The questioning technique for tolerance determination does not necessarily pick the best quality possible, but the most functionally suitable.
36. The rate of output in the weeks immediately preceding longer holidays — known in the north as "Bull" weeks — especially in industries on direct bonus schemes, is proof of this condition. Also see Paper by H. F. Rothe in "Journal of Applied Psychology" Vol. 34. No. 2. April, 1950.
37. This percentage is quoted from the Press and should be treated arbitrarily.
38. As set out in the "Industrial Engineering Handbook".
39. A definite task, a definite method and a definite time — with all the auxiliary controls and devices.
40. Dr. E. Jacques in "Payment by Responsibility" proves this point. Although he does not accept "job evaluation" he has, in fact, presented a new job evaluation plan.
41. Dr. William H. Knowles, "Industrial and Labour Relations Review", Vol. 5. No. 2. 1952.
42. Prof. Jules Backman in "The Economics of Annual Improvement Factor Wage Increases". New York University.
43. Mr. C. E. Wilson, President of General Motors Corporation, as quoted by Prof. Backman.
44. Prof. J. Backman, "The Economics of Annual Improvement Factor Wage Increases".
45. Cecil Chisholm in "Communication in Industry".
46. Cecil Chisholm in "Communication in Industry".
47. Cecil Chisholm in "Communication in Industry".
48. Cecil Chisholm in "Communication in Industry".
49. Dr. Walker in "Productivity and Progress". Australian Institute of Political Science.
50. The present shortage of teachers and the resultant rise in costs and lowering of standards is a typical example. The probable surplus of medical graduates in the near future could also be attributed to a lack of facilities for long-term planning.
51. As set out in the Appendix to "Conference on Work Study", B.I.M. May, 1954.
52. In unorganised plants the term "Production Controller" seems almost mythical. He is in danger of losing either his job or his principles when it comes to meeting day-to-day needs.
53. See Section 4.
54. See Section 4. Full employment also contributes. In the "Michigan Business Review" (Vol. X, No. 2) Shepherds writes: "Resolution:- He would do without before hiring any more '51 percenters'. A '51 percenter' was one who was just good enough to hold a job but not bum enough to fire". The U.S.A. has not only more unemployment but also better labour mobility than Great Britain.
55. See Section 4.
56. Institutions are as much responsible for such an exposure as individuals. (1) The Anglo-American Council Report on "Industrial Engineering" has confused executive responsibility with that of industrial engineers. (2) In her enthusiasm to "sell" the "Incentive scheme for Inspection Work", Mrs. M. Alan has confused the functional role of "Inspection" and "Quality Control" duties, ("Time and Motion Study", September, 1957.) Many more instances could be cited.
57. In the U.S.A., the Military, Labour and other Government Departments, as well as many Universities, not only conduct and sponsor such work but invite and receive labour and management co-operation and financial help.
58. For conclusions in graphic form, see Fig. 4.
59. Dr. S. Radhakrishnan in "East and West, Some Reflections".
60. However useful the outcome, representation on the "Anglo-American Councils on Productivity" and other conferences like the "H.R.H. The Duke of Edinburgh's Study Conference on Human Relations in Industry" take the division for granted.
61. Dr. G. H. Copeman in "Leaders of British Industry" has assumed this ratio for his work. His assumption was based on the statistics of 1951. Since then, more nationalisation has taken place, and corporate ownership has continued its popularity.
62. I.C.I., one of the biggest employers in the country and possibly in the world, proudly announce this fact through their advertisements in the press.
63. U.S. Information Service has adopted the term and issued a booklet describing the details of working of "Consumer Capitalism" in U.S. economy.

THE HUMAN FACTOR IN WORK STUDY

by C. SPECTOR, B.Sc. (Econ.), A.M.B.I.M., A.I.Prod.E.

IF we are agreed that the aim of work study is to increase productivity, and so raise the standard of living of everyone in this country, that in itself is a desirable aim. If, however, this aim is achieved only at the expense of the happiness or well-being of the workers, then the desirability of work study could be questioned.

This, then — the social consequences of work study — is perhaps the cardinal problem in the application of work study. It has been the social consequences that has caused so many misconceptions and has been the basis of so many fears generated by the very term, work study. What are the human implications involved in the introduction and application of work study in an industrial undertaking? What are the natural reactions of people to technical innovation and technical change?

In recent years, writers on this subject have been mainly concerned with the human problems involved in the introduction of work study. They have emphasised the importance of getting the trades unions together with the managements at a very early stage, and securing worker-management co-operation before any attempt is made to introduce the work study technician on to the shop floor. Again, they have been at pains to emphasise the need for a gradual introduction of new methods and techniques in the early stages and for an effective system of communications to operate throughout. This would ensure that grievances would be dealt with almost as soon as they arose.

Again, others have stressed that the human implications of work study have revolved around the personnel problems of redundancy, of a fall in wages due to loss of overtime earnings, or of having to do more work for less money. To support these fears, writers have looked back into the history of industrial development and of the more restrictive practices that have been adopted at one time or another. Introduce a new atmosphere of mutual trust and goodwill into an industrial organisation, and these fears will disappear. Richard Bissell, in his fascinating novel, "7½ Cents", destroys this idea in two short lines. Referring to a dispute over times and rates, the manager mentions mutual confidence. The operator retorts: "You can't eat mutual confidence."

This is not to belittle any of the writings and contributions made on the subject. It would be quite wrong to suggest this. What is more important, is a newer, more dynamic view of work study and its rôle as a management technique in an industrial undertaking. This view endeavours to show that, properly applied, it is a technique which can be used to improve human relations within an organisation. It would seem, therefore, to be more appropriate to examine work study and the human factor from this standpoint. If work study can raise output and living standards, as well as improve morale and induce genuine co-operation in industry, then the other problems of redundancy, of reduced hours of work, of piece rates being more scientifically measured, would in themselves, be solved more amicably.

a creative process

Winston Clowes has stated that work study is primarily concerned with human beings . . . that production is a creative rather than a mathematical process [1]. In other words, if an organisation is thinking realistically about work study, it must analyse its human relations situation first. Analysing the human relations situation means an examination of the existing social structure. This examination first began with the work of Roethlisberger and his associates at Hawthorne, and paved the way for such systematic examinations of the social structure of an English factory as the Glacier Metal Project by Elliot Jacques and his research team [2]. This social structure that provides the basis for factory organisation, and involves the system of management, the lines of communication, the management worker relationships, the official and unofficial organisation

of the people involved in the manufacture and distribution of the end-product, is not static. It changes as external factors, economic, social and political, change. It will also change as technical changes are introduced within the organisation.

variance in attitude

From our study of human behaviour, it has been shown to be quite in the natural order of things to assume that people view change with varying attitudes. These attitudes are reflected in different forms of behaviour. For example, people's attitude to the introduction of a new system of stores control will vary. There will be those who welcome it, will enthuse over the new system, and co-operate eagerly with those who are responsible for applying this control system. To others, this will be regarded as yet more unnecessary paper work, a hindrance to production, and they will endeavour to have as little to do with this method of control as possible. By ridicule, by passive resistance, by open or hidden opposition, they will seek to discredit it and perhaps persuade the executives to revert to the former system of stores control. These emotional responses will affect the social structure, and could easily result in a deterioration of human relations within the whole organisation.

This is a view which has latterly been put forward by a number of psychologists and sociologists working in industry, and has been called the socio-technical systems 3. In every organisation there are technical methods, processes and systems at work in order to produce the goods and services. But this is only one aspect of manufacture. In every organisation, people have to combine and co-ordinate in different ways and in different groups, in order to develop the technical systems of work. To operate these technical processes, a social structure is established, with its own pattern of behaviour and morale code. Orders and instructions follow a definite path, and a general pattern of discipline is imposed and maintained. Custom and practice regulate life and give a sense of continuity and orderliness to the people working in the organisation. Any changes in the technical methods of working, for example, by the introduction of new methods, or new time standards or product design, or work simplification, will affect the social relationships already existing. In the same way, changes in the social structure, by a re-development of labour, job evaluation, or re-tooling mechanisation will affect technical efficiency and productivity. This interdependence of the social and technical systems at work in an organisation has only recently been realised. This has been brought home most vividly in a study of the coal mining industry in this country, where two contrasting methods of coal getting, operating under similar technical conditions, yielded enormous differences in productivity 4.

The Longwall Advancing Method of getting coal involves a coal face of something like 750 ft. long, which is large enough to accommodate the modern mechanical aids and equipment used underground. Because of the size of the area involved, it is usual for three shifts each of about 40 men to work it. However, only one shift actually gets the coal, the other two acting as rippers (maintaining the roadway) and fillers (loading the coal on to the conveyors).

The other method is known as the Room and Pillar Method, and usually involves small groups of three miners each responsible for a small part of the coal face and all sharing in the task of cutting the coal and filling. From the technical point of view, the first method is vastly superior in that it enables more coal to be worked from the seams, fewer roadways to be constructed, a greater use of mechanical coal cutting and mechanical handling of coal.

However, to quote from the Reid Report, the Government Technical Advisory Committee on Coal Mining, set up in 1945 : " the small groups (in Room and Pillar mining) encourage a greater team spirit ... in the Longwall method, non-attendance of workers may have a disproportionate effect on output. It is ... difficult to maintain a proper standard of performance and discipline."

A further study by Trist and Bamforth has shown that the small teams have a greater sense of pride in their craft, and for two shifts out of every three in the Longwall method, the men were physically divorced from the actual physical job of

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coal getting. Again, the Longwall method encouraged "back-biting" between the shifts. The men became divorced from one another. Working on different shifts means living different lives; friendships are disrupted and the whole social life of the mining villages and the mining communities is thereby affected. In the Room and Pillar method, the three men were also aware of the dangers to which they were all exposed. This was not quite so apparent in the other method, since only one shift was concerned with preparing and controlling the face.

Actually, as a result of the social factors being brought into prominence, certain regions are now trying to combine the social advantages of small working groups with the technically superior Longwall method.

inter-personnel relationships

We have now seen that work study affects human relations in industry most markedly, in that it involves changes in inter-personnel relationships that often produce a fall in morale, and a failure to reach the expected norms of output. In the almost classic Harwood Manufacturing Corporation case [4], girls who had to leave production lines to return to the training department and learn a new job expressed their dissatisfaction by a failure to reach their standard 60 performance output, or by leaving. A further investigation showed that even the girls who stayed often became trouble-makers and attempted to depress the group standard of output. A reason for their fall in morale was the fact that these girls were taken out of one set of social relationships, the team of girls and friends with whom they were working, and drafted, somewhat brusquely, they felt, into another and completely different set of social relationships, the training centre. All this was being done in the name of efficiency, and in a company which had enjoyed excellent labour relations for many years. A new method, known as group participation, had to be employed to overcome this resistance to change, a method developed by the social psychologists.

It is one thing to chart the expected percentage rise in production, with the introduction of new machines, but quite another thing to attempt to forecast what the expected individual performance of the operator will be under the new conditions. It is comparatively easy to calculate the expected savings in material or machine time when a new method of work is planned. It is not so easy to calculate the operator's attitude to the new method and his degree of willingness and co-operation. In the past, attention has been rivetted on ways of reconciling these differences, of smoothing them over. References have been made to improving communications, of consultations with the unions, of organising courses and conferences. These have been seen usually as the best means of maintaining human relations, or of ensuring that the human factor in work study is not overlooked.

Recent researches into the processes underlying working groups and of the complex pattern of group structures, and the social organisation that is set up in a working organisation, show that the group has a dynamic of its own. The earliest, and perhaps the most exhaustive, study yet made into the social processes that develop in a factory, the famous Hawthorne experiments at the Western Electric Company near Chicago, showed the existence of groups and cliques within a department that assist or retard productive efforts. Attitudes that develop towards the supervisor, as for example, in the Bank Wiring Room experiment, showed that where these were favourable to the foreman, then they produced high output. The reverse trends in attitudes resulted in a deterioration in morale and output.

This aspect of morale and productivity, and its relationship to the underlying social structure of working groups, has been one of the major fields of study undertaken by the Research Centre for Group Dynamics at Michigan and also by the Tavistock Institute of Human Relations in this country. In fact, in the most recent study of all, that conducted by Ken Rice at Ahmahabad in cotton mills, shows that the readjustment of working groups can lead to an improved output. This, in fact, was achieved. In this case changes were made in the organisation of the mills. Various men were re-deployed and new groupings were formed. These groups were more closely related to the methods of production, and tended to become much more closely knit and integrated. In fact, there were no technical innovations introduced at all, yet there was an immediate and encouraging rise in productivity. Similar studies in the organisation of offices of the Prudential Assurance Company in the U.S.A. have shown that restructuring of working groups can lead to higher morale and higher productivity.

Work study, then, can be seen in a different setting. It could be regarded as a scientific tool of management which has as its aim the integration of groups, the increase of group responsibility, the broadening of operator skill, and the improvement of worker-supervisory relationships.

social examination

Just as a technical examination of existing methods and techniques of work are regarded as an essential prerequisite of work study, so should the social examination of people at work be undertaken. Hidden conflicts, distrust over present wage rates, or of comparative work loads, of inspection standards, of fatigue and rest allowances, would be laid bare and rectified by the new time standards, the methods, or work planning that is introduced. Professor Cummings, a Consultant for the European Productivity Agency, has stated this factor to be of supreme importance [5]. If human relations are developing positively, and people are gaining skills and confidence in relating themselves to each other, participation simply evolves as a natural and changing expression of the group. Each one will be participating; in any event management simply decides whether to force it underground, or gradually

encourage it into the open to be responsibly utilised. In fact, by improving worker participation in the application of work study and by encouraging active analysis and criticism of it in practice, group cohesion is effectively strengthened and workers' enthusiasm and loyalty for management is heightened and social insight is developed.

Work study becomes recognised as an attempt by management, in conjunction with the workers, to raise standards of efficiency, and to relate this to the changing needs of the social organisation. The fact that these needs are recognised as being present will raise morale and productivity, and have as a further effect, the gaining of insight into the social forces operating within working groups on the part of management.

I will conclude with a simple practical example [6]. Management were concerned with the behaviour of three women in the inspection department of a shoe factory. They felt that an unnecessary amount of time was spent by the women on gossiping, which affected their rate of work. It was argued that careful visual examination of each pair of shoes for minor faults precluded talking. In order to raise the overall efficiency of the department, it was suggested that the working positions of the girls should be re-organised so that verbal communication would be impossible. The work study department undertook a number of ratio delay studies to determine the percentage of wasted time to effective working time, and discovered that it was only slightly above the average. A closer investigation of the social structure of the group showed that it was a closely knit group under the leadership of the oldest worker in that group. To have split them up would have resulted in a considerable fall in morale. The technical advantages of dispersing the group would have been largely outweighed by the social consequences. In fact, the recommendations were not only to leave the group intact, but to utilise the cohesion of the group by making them responsible for setting their own production targets, and for the natural leader of the group to be responsible for charting actual production with the standards set by the group. As Jerome Scott has stated [7], effective controls consist in collaborating with the group in such a way that the group itself evolves norms of behaviour having the desired controlling effect.

What I have suggested does not imply that work study practitioners should be psychologists. They should be aware that their job is primarily concerned with people and that their aim should be to raise efficiency of the working group in every sense, regarding their field as being a social as well as a technical one. Improvement of social efficiency is, in fact, an improvement in human relations.

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THE FIFTH CONFERENCE OF ENGINEERS RESPONSIBLE FOR STANDARDS

A Report of the meeting organised jointly by The Institution of Production Engineers and The British Standards Institution and held at the Connaught Rooms, London, on 4th June, 1959.

THE Chairman, **Mr. H. A. R. Binney** (*Director of the British Standards Institution*) welcomed those present and remarked on the increasing interest in these Conferences, shown by the steady growth in attendance; it was an occasion on which representatives from different branches of industry, from Government departments and from technical colleges concerned with the training of engineers and managers, could learn from one another and influence the application of standards in the country. The Conference was organised and the Agenda drawn up by the Joint I.Prod.E./B.S.I. Committee on the Use of Standards in Industry, and he expressed his appreciation of the work of that Committee.

Introducing **Lord Halsbury,** the opening speaker, the Chairman referred to the many offices of national importance in which he had served, including that of Managing Director of the National Research Development Corporation, which he had brought to its present position of importance and influence, as well as his many posts in industry itself, to which he had now returned. It was appropriate that the Conference should be opened by one who was a scientist, an industrialist and a Past President of the Institution of Production Engineers.

Lord Halsbury expressed his pleasure at being invited to open the Conference; he had a long association with standards work and he recalled that he had in 1929 been Secretary of an International Standards Committee concerned with methods of analysis of oils, fats and waxes. The problem of standards was ever with us; as in the proliferation of languages from the Tower of Babel onwards, and the development of yards, metres, pounds, kilogrammes and different screw thread systems, the spontaneous drive for variety was always stronger than the drive for uniformity. Standardisation would collapse if not strongly defended; its price was perpetual effort.

Lord Halsbury referred to the need for management to give the right kind of encouragement to standardisation, *first* by providing the enthusiastic man with authority and facilities to carry out his work and not merely asking someone with another job to do, to "keep an eye" on standards matters (this would mean that he would get it out of perspective) and, *second,* by encouraging standardisation through the firm's pricing policy; too often as much as 30% of a firm's products were non-standard and were excessively expensive to produce but the customer was not charged the full price, whereas the right policy would be to charge heavily for such items, to encourage the sale of those which were standard and eliminate those which were uneconomic.

Lord Halsbury said that though the number of firms applying standards was growing, as shown by the increasing attendance at these annual conferences, the number outside must still be very large and the drive had still to spread much further. More productivity could always be squeezed out of a production process and standardisation was a potent means to higher productivity. National standards must be supplemented by international standards as a means of simplifying the exchange of goods, e.g., between the U.K. and the U.S.A. He regarded the Conference as part of the collective defence of standardisation.

Mr. J. H. Barclay (*British Oxygen Gases Ltd.*) congratulated Lord Halsbury on bringing out so many key points, particularly the need for proper costing and allocation of overheads to eliminate the unprofitable items in a firm's production. He thought that the Institute of Cost and Works Accountants should be represented at the Conference.

The **Chairman,** commenting on Lord Halsbury's reference to international standards, emphasised their importance and the need to reach agreement as early as possible. He instanced the case of screw threads on which international agreement had just been reached on two series of sizes; the existing multiplicity of threads might have been avoided if I.S.O. had existed 100 years ago.

Mr. H. A. R. Binney, C.B., Director of the British Standards Institution, welcomes the delegates. On the left is The Rt. Hon. the Earl of Halsbury, then President of the Institution of Production Engineers, and on the right is Mr. G. Weston, Technical Director, B.S.I.

THE OPERATION OF A COMPANY STANDARDS DEPARTMENT

Paper: draft of a booklet "The Operation of a Company Standards Department" prepared by Mr. S. T. Robinson in collaboration with a panel of the I.Prod.E./B.S.I. Committee, for publication by the B.S.I.

Mr. S. T. Robinson (*S. Smith & Sons (England) Ltd.*) introducing the draft, said that its preparation had followed from the last Conference, at which speakers had called attention to the lack of available guidance to the newly-appointed standards engineer on how he should carry out his task. Most of the available literature left off at the point at which his draft started. He emphasised that the booklet presented the material very briefly and much was left out — there was scope for a much more detailed publication. The Panel which had helped to prepare it agreed on most of the functions of the standards engineer, but differences of terminology had emerged and further standardisation was required. In inviting the views of the Conference on the draft — a new way of circulating a B.S.I. "draft for comment" — he said that it would be particularly useful to know from those who were not running a standards department whether it would help them in getting started. As regards the examples of company standards to be given in one of the Appendices, Mr. Robinson referred to examples displayed in the Conference Room which were mainly from his own firm; he would welcome it if other examples could be sent to him so that the Appendix should be as representative as possible.

DISCUSSION

Mr. R. E. Mills (*H. M. Hobson Ltd.; Chairman, I.Prod.E. Standards Committee*) said that Mr. Robinson's draft in dealing with "evaluation of results" suggested that standardisation needed to be "sold"; this he could not support — standardisation was a fundamental principle.

Mr. Robinson said that he himself thought that results could not be fully evaluated, but there was a demand for some evaluation and the draft indicated some possible ways of attempting it.

Mr. E. H. Williamson (*The Distillers Co. Ltd.*) welcomed the proposed pub'ication as a great help to the newcomer to standards engineering but stressed the value of a period of, say, six months in an established standards department, or in the B.S.I. He disagreed with the definition of "simplification" as eliminating inconsistencies and remedying inadequacies and with the implication that standardisation stopped at publication of a standard — the standard must also be app'ied. He thought that the booklet might usefully refer to work study and the five classic questions which were fundamental to that subject.

Mr. Robinson said that Mr. Williamson's comments illustrated the difficulties of terminology to which he had referred. He agreed to consider Mr. Williamson's suggestions.

Mr. F. C. Fuke (*Admiralty*) also welcomed the proposed publication. He suggested that the reference to "release of capital through reduction of stocks" as one of the tangible savings which arose from standardisation, brought out only the retrospective remedial action which might be taken, and the function of the Standards Department was to control and prevent the proliferation of stock at all times. Essential to this control and to the prevention of unnecessary expenditure on drawings and on the introduction of new components, was the allocation of drawing and part numbers under a classified system. Mr. Fuke considered that more emphasis might be given in Part 3 of the draft to the basic requirement of classification in addition to the exposition of it in Part 6.

He disagreed with Mr. Mills as regards "selling" standardisation — the standards engineer had to make the standard and then "sell" its adoption.

Mr. Robinson accepted Mr. Fuke's first point. He also agreed on the importance of classification, but pointed out that the booklet could not do more than outline the problem — the new standards engineer would need further help on this subject.

Mr. B. H. Dyson (*formerly General Manager, Overseas Production, Hoover Ltd.*) illustrated the value of inter-company standardisation by the example of the Swiss watch industry, composed of a large number of small firms which had co-ordinated their production and standardised components. He questioned whether a "standards department" in a firm was the right arrangement, deploring the addition of a new department, and suggested that the standards specialist might be attached to an existing department — the accounts department, or preferably the design or engineering department.

Mr. Robinson said that in a firm of large size it would be necessary for the standards engineer to constitute a department in order to carry out the operations of establishing, printing and publicising the company standards; in the smaller firm a single specialist attached to an existing department might be sufficient.

Mr. L. W. Richards (*Bristol Aircraft Ltd.*) emphasised the importance of classification to the drawing office; in the absence of quick identification and location of existing drawings the draughtsman would make a new one. He thought that the principles of classification should be standardised.

Mr. H. Stafford (*United Steel Companies Ltd.*) disagreed with Mr. Dyson's suggestion that the standards engineer need not have a separate department. The standards engineer was the man who should cut across all departments. As regards the evaluation of standards, he said that it should not be necessary to evaluate; standardisation was a principle. But management nevertheless had to be convinced from time to time in financial terms.

Mr. R. S. Geoghegan (*E. G. Brisch & Partners Ltd.*) said that in the publication the purpose of the company Standards Department should be described as to save money through the "elimination" and not the "reduction" of unnecessary variety. He strongly supported Mr. Richards in his emphasis on the importance of classification and identification, and suggested that the section on this subject should be expanded and clarified. A proper coding system would provide all the means to find an item, whether physically or on paper.

Mr. F. S. Naylor (*Central Electricity Generating Board*) indicated the size of his problem in initiating a standards programme by the fact that the Generating Boards were concerned with £800,000,000 of construction work and a £12,000,000 stores holding, mainly supplied by outside manufacturers. The differences in terminology he encountered suggested that there was a need for standard terminology and a national coding system.

Mr. Robinson said that much was done by B.S.I. on standardising terminology in various fields, but it might be useful for the I.Prod.E./B.S.I. Joint Committee to set up a special panel on the problems of terminology.

Mr. S. J. Patmore (*S. J. Patmore & Partners*) referred to the problems of selling standards to the smaller firm. He urged that the booklet should be distributed as widely as possible and that, to sell standardisation, it should contain some indication of the cash value of applying standards.

Mr. Robinson said that the purpose of the booklet was not to "sell" standardisation; it started from the assumption that a policy of standardisation was accepted and indicated how it should be implemented.

Mr. R. K. Whitehead (*English Electric Co. Ltd.*) suggested that the booklet could usefully contain a reference to the problems involved in changing existing standards. For example, the change to the new international thread would be very costly and customers would not be prepared to change at a given date, with the result that double stocks would have to be carried for, say, 10 years, involving very heavy expenditure, for which allowance would have to be made in the budget. In such special cases where a fundamental change was required, standardisation might prove more costly than non-standardisation.

Mr. Robinson agreed to consider this point.

Mr. W. J. Yeandle (*Sperry Gyroscope Ltd.*) said, in regard to evaluation, that it was possible to make an estimate of savings made by avoiding new design of piece parts, and instanced a saving of £800 by the standardisation of 16 parts.

The **Chairman** said it seemed clear that the Conference regarded the proposed booklet as serving a useful purpose; the drafting Panel would revise it in the light of the views expressed but its general scope and size would not be significantly altered.

SIMPLIFICATION: APPLICATION OF STANDARDS IN THE FIRM

The Chairman introduced **Mr. Bertram White** (*Managing Director, A. Boake, Roberts & Co.*) *whose keen interest in the techniques of the "three S's", membership of Anglo-American productivity teams and experience in his own firm made him a particularly acceptable speaker at the Conference.*

Mr. White defined simplification in a firm as the reduction in types of products made; standardisation

was the specification of quality on other features of products whether made by the firm or used in its production processes — in his own Company this was controlled by a specifications committee representative of the Sales, Production and Research Departments. Mr. White described the process of simplification carried out by his firm over the last few years which had resulted in a drastic weeding out of individual products and whole groups of products. Thus, out of 1,500 chemical products manufactured five years ago only 221 regular products now remained. The way this had been tackled was by examining the turnover and sales value of each product, eliminating first any of which less than £100 worth were sold each year, with further examination of others where the gross profit was below a certain figure and taking into account whether sales appeared to be on the upgrade or not; as a result, whole groups of products as well as individual products were eliminated. As a means of helping buyers of the discontinued lines, Boake Roberts had negotiated with other firms to take on the supply and, in the case of the whole range of chemicals for the brewing industry which was given up, arrangements were made with a number of smaller companies to take over the know-how, trade marks, etc., on the basis of a royalty agreement over a period of years.

Mr. White listed the gains made from this simplification operation — longer production runs with elimination of interruption and wasted time on cleaning of machines, with reduction of production costs; reduction of stocks; less special purpose plant with all its attendant costs — real "selling" of the firm's products instead of mere offering of a catalogue list; reduction by half in the number of orders but increased size of orders, the turnover being higher than before with reduction of costs of paper work on orders (an expensive overhead). He said, however, that in his own experience the general reduction of overheads which might have been expected to match the reduction in products had not yet been achieved. Mr. White pointed also to the beneficial effects on the research and development programme of a simplified range of products. The efficiency of research was greatly increased if it was not diffused over a mass of products.

Mr. J. H. Barclay (*British Oxygen Gases Ltd.*) asked how Mr. White's Company controlled the adoption of new products as distinct from eliminating those existing.

Mr. White said that a small committee within the Product Development Department was responsible for exploring the market for new products and trying them out; when a certain tonnage of sales was reached the product was then considered for the sales list and, if accepted, would be transferred to the normal selling arrangements.

Mr. H. Stafford (*United Steel Companies Ltd.*) said that though Boake, Roberts & Co. had no official "Standards Department", it was clear that the Managing Director was the Standards Department.

REPORT BY THE B.S.I. ON RECENT TRENDS IN STANDARDS WORK

summary of Paper

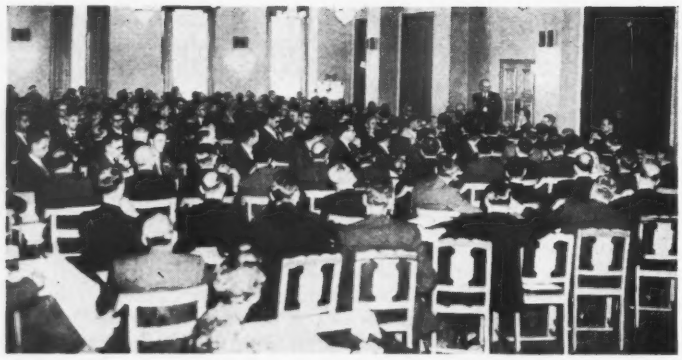
international aspects

The growth of the International Organisation for Standardisation (I.S.O.) and the International Electrotechnical Commission (I.E.C.) work is illustrated by the number of new Committees starting and the number of recommendations coming forward. There is a development in a number of Committees from the stage of methods of test to that of specifications for materials and products. The B.S.I. is to give more publicity to international standards and their relationship with national standards of the same scope. The problem of the use of inch and metric measures in international standards, illustrated by the agreement on two series of screw threads, inch, unified and metric, with a common basic profile (that of the unified thread) is a constant feature; there has been success in some fields, e.g., ball and roller bearings, pallets, some small tools, in finding a single series of dimensions, whether expressed in inch or metric units, but in others parallel series have to be accepted and collaboration of the inch-using countries is needed to ensure the acceptance of a satisfactory inch series. Commonwealth co-operation helps in this and in other aspects of standards work.

The participation of the U.S.A. in international work is growing but could with advantage be much greater. Criticism to this effect was made by the Director of B.S.I. in a Paper to the U.S. National Conference on Standards last year. The development of unified standards in the Common Market countries and the combined strength of these countries in I.S.O. and I.E.C. are important factors to be reckoned with. There is an increasing interest in the U.K. in the metric standards of these countries and in some cases they are being made available in British Standard publications. While the need for special presentation in accordance with overseas specifications will always remain, attention needs to be given to the acceptability of British Standards in overseas countries, both as regards their content and their presentation. The translation of summaries of British Standards into foreign languages has been initiated in the iron and steel industry and other industries may be well advised to follow this example.

preparation of British standards

New work is coming forward in increasing volume and in an extremely varied range. Co-ordination of standards for steel and non-ferrous metals is progressing and co-ordination of testing requirements for various types of prime movers is being considered. Other features of the vast range of projects in hand are the developments in standards connected with the use of computers — cards and tape, coding methods, presentation of data — standards incorporating the modular principle in building, standards for agricultural products with the development of I.S.O. work in this field, tests and ratings for flammability



Members of the Standards Conference listen to Lord Halsbury deliver his opening address.

of fabrics. Increased interest in the use of I.S.O. recommended paper sizes is evident and a British Standard covering these sizes has been prepared.

DISCUSSION

The **Chairman,** introducing the report, laid stress on the volume and importance of international standards work now in progress. He referred to the various groupings with which the U.K. was associated in this work: the Commonwealth, where there was regular contact between the standards organisations as well as periodic conferences on general and technical subjects; the "A.B.C." with its work on fundamental engineering standards; the I.S.O. and the I.E.C., whose work over the past 10 years had broadened and accelerated; the European Common market and potential Free Trade Area countries, with the recently established arrangements for participation by the other countries in the technical discussions for the alignment of standards among the Common Market countries. The elimination by legislation of tariffs and quotas among those countries would not of itself bring about a free flow of trade if differences in standards practice persisted. While the association of the U.K. and other countries outside the "Six" with the standards discussions was a useful step, the strength of the "Six" in wider standards discussions in I.S.O. and I.E.C. could have serious effects on our interests.

Referring to the help given to B.S.I. by its Export Panel, the Chairman mentioned its anxiety that B.S.I. should do more to make contact with the developing countries; members of the B.S.I. staff had made a number of visits to such countries in the past year or two, to the Middle East, Rhodesia, East Africa, the West Indies and Chile, and while the natural tendency in these countries was to look to the international standard, if it existed, there was also scope for the acceptance of British Standard techniques. The Export Panel was also much concerned with the presentation of British Standards in overseas markets and the recent report of the F.B.I. Committee on Export Facilities had recommended that more should be done.

Supplementing the Chairman's comments, **Mr. G. Weston** (*Technical Director, B.S.I.*) gave examples of the new work being undertaken in the international field — on cranes, mechanical handling equipment, mining, radio-isotopes and other subjects. This new work involved the setting up of about 20 Working Groups on all of which the U.K. would be represented— a formidable addition to the programme. In existing I.S.O. committees new aspects were being taken up — following the completion of about 30 methods of test for steel, work was being started on specifications for heat-treated and structural steels. Instancing important projects which had recently been completed, Mr. Weston mentioned the revision of the I.E.C. publication on Rotating Electrical Machinery, taking account of advances in use of insulating materials, the Machine Tool test code agreed at the Harrogate meeting in 1958 and the agreement on the unified inch and metric series for screw threads.

Mr. D. Wilman (*A.E.I. Lamp & Lighting Co. Ltd.*) asked about the position of the International Commission on the Rules for the Approval of Electrical Equipment (C.E.E.), which had not been mentioned in the B.S.I.'s report; the electrical industry had put much effort into it but its work on safety was often carried to academic limits and sometimes overlapped with that of the I.E.C.

The **Chairman** said that the Continental constitution of the C.E.E. meant great difficulties for the U.K. and though efforts were being made to draw the C.E.E. work as far as possible into that of the I.E.C. on safety aspects, the emphasis of the C.E.E. work was on approval and testing specifications while the I.E.C. approach was more from the manufacturing side.

Mr. F. W. Campbell (*British Thomson-Houston Ltd.*) said that it was not clear whether foreign customers would ask for goods made in accordance with international specifications as well as with British Standards, and whether this would involve making to two specifications.

The **Chairman** said that the way the international specification was intended to be used was by its incorporation in national standards. Since the U.K. was in nearly every case closely associated with the drawing up of the I.E.C. specifications and was in agreement with them, compliance with an I.E.C. specification would normally be satisfied by making to the corresponding British Standard.

Mr. P. Colston (*Rolls-Royce Ltd.*) said that in selling new engines in a large international market the problem of what standards to use was a very difficult one. In this rapidly developing section of industry standards tended to lag behind the new techniques. The industry often had to buy parts which were non-standard to the domestic suppliers and to comply, e.g., with American standards for the U.S. market. These problems needed urgent attention from the B.S.I.

Mr. Weston said that these problems were appreciated; one step which was needed was for the aircraft industry in the U.K., which worked to its own special standards, to move over to the general engineering standards adopted by industry as a whole; co-ordination of these with U.S. standards was helped by the "A.B.C." machinery.

REPORT ON THE WORK OF THE I.PROD.E. STANDARDS COMMITTEE

summary by Mr. J. H. Winskill

THE problem of ensuring the adoption of good standards is a very complex one, in which the B.S.I. is helped by trade associations and technical institutions; the securing of the user viewpoint is particularly difficult. The Standards Committee of The Institution of Production Engineers represents a large body both of manufacturing and user experience and is a good forum for bringing together information to help in the production, amendment or revision of standards; it ensures a balance between the ideas of the new and over-enthusiastic and the old and more experienced.

In bringing special problems to B.S.I.'s attention and also in advising B.S.I. on some of those which arose in B.S.I. Committees, much "off the record" research was undertaken either through its members or their associates. Among the matters with which the I.Prod.E. Standards Committee had recently concerned itself were the symbols used in connection with machine tools, the nomenclature for cutting tools and the design of tools and lathe spindle noses. Again, in connection with the standards for drawn tubes, the I.Prod.E. Committee had tried to iron out difficulties between the various users of such tubes, where, as new uses developed, the old standards which had been satisfactory, for example, the gas and water industries, were unsuitable for the aircraft industry.

The Committee had also tackled the problem of unit heads, where the lack of standard leading dimensions had caused great difficulty in the workshops — after two-and-a-half years' work a draft standard had now been prepared. An important function of the Committee was to try and find out the reasons why British Standards were not widely adopted and to suggest changes to make them more acceptable. In this connection Mr. Winskill expressed regret that there was not more co-operation from users in commenting on draft standards; better and more widely used standards could be set up if more information on practice were supplied.

The **Chairman** thanked Mr. Winskill for his report.

PROGRESS REPORT BY THE I.PROD.E./B.S.I. COMMITTEE

summary of Paper submitted

The question is raised whether the present type of Conference is the most suitable and whether more discussion of detailed technical subjects may be desirable. The conclusion of the I.Prod.E./B.S.I. Committee is that for an annual conference of Standards Engineers an agenda of fairly broad interest is best, supplemented as may be practicable by meetings of smaller groups on more detailed subjects in different parts of the country. This leads on to the question of the setting up of an Association of Standards Engineers or possibly a section in the U.K. of the Standards Engineers Society (U.S.A.). Suggestions have been made that an association might be formed under the wing of an existing body — one or other of the professional engineering institutions, or the B.S.I.

education

The increasing interest in "variety reduction" techniques is reflected in conferences and seminars run by the British Productivity Council and plans for inclusion of the subject matter in technical college courses.

inplementation of Standards

The 1958 Conference proposed various measures that might be taken to ensure that goods made in accordance with British Standards are available and can be easily obtained. These measures included publication by B.S.I. of a "Buyers' Guide" giving lists of manufacturers prepared to supply, and the wider use of certification mark schemes. B.S.I. has the first point under consideration and has been asked by the I.Prod.E./B.S.I. Committee to draw attention to the whole question in its publicity. Lists of firms licensed to use the Certification Mark have been published.

DISCUSSION

The **Chairman** said that the report dealt with certain matters which had been discussed at previous conferences and other matters considered by the I.Prod.E./B.S.I. Committee. Members of the Committee particularly interested in the various items dealt with in the report would open the discussion on them.

(*a*) *Future of the Conference: formation of an Association of Standards Engineers*

Mr. Mills said that an Association, if it were to be formed, must be based on strong support and not on the enthusiasm of only a few; there would have to be an assurance that those forming it would be prepared to put a great deal into it and would have the backing of their companies in doing so. Careful thought would also have to be given to the scope of the association, to what it could achieve and the qualifications for it. He personally thought that it might well be formed within one of the professional institutions, perhaps The Institution of Production Engineers.

Mr. Patmore said there was room for the establishment of a body to recognise the work done in applying standards. Since every technical institution was represented on B.S.I.'s committees and interested in its work, he thought that B.S.I. should sponsor and run an association and set the standards of qualification for it.

The Chairman said that the question whether B.S.I. should sponsor an association was a matter more of policy and judgment than of constitutional position. He himself felt that B.S.I. should not be the leader in this, though it would support and help any movement to establish an association. He read the contents of a letter from the Chairman of the International Membership Committee of the Standards Engineers Society which drew attention to the possible advantages of a U.K. association starting as a section of the Society, and which referred to the forthcoming visit of one of its members from the U.S.A., Mr. Terhune, who would like to discuss the matter with the U.K. members. The Chairman indicated that he would be meeting Mr. Terhune and said that he felt the Society's proposal should be considered sympathetically both in itself and as a means of developing an international organisation of associations.

Mr. H. I. C. Howgate (*Marconi Instruments Ltd.*) was against attaching an association to any of the professional societies and thought its sponsorship was the responsibility of the B.S.I.: the question of qualifications was not important.

Mr. Stafford supported this point of view — the sphere of the standards engineer cut right across industry and attachment of an association to B.S.I. rather than to one particular section of industry would be the right course.

Mr. W. H. Crown (*Kelvin & Hughes Ltd.*) said that the early development of the Institutions of Electrical and Mechanical Engineers had been carried out by keen founder members, and the question of qualification had not then been significant; the B.S.I. should bring together a core of enthusiasts, and proposals for an association could be formulated well before the next conference.

Mr. G. F. de C. Sizer (*B.S.I.*) said he was a member of the Standards Engineers Society and indicated some of the advantages which an association in the U.K. would provide — a forum for discussion, clarification of the objects of standards engineering, literature on the subject, social contacts, etc.

Mr. Patmore urged that quick action should be taken to get an association under way and proposed a resolution that the B.S.I. be requested to form a panel which would go into the question. He suggested that the panel should include representatives of the professional institutions and some of those present at the Conference.

The **Chairman** asked that the nucleus of the panel should be the standing I.Prod.E./B.S.I. Advisory Committee with suitable additional co-opted members. This was agreed. He undertook that B.S.I. would see that energetic steps were taken — he hoped that an open meeting could be arranged to consider proposals put forward by the Panel.

The resolution was seconded and carried with three dissentients.

(*b*) *Education: courses on standardisation*

Mr. Weston referred to the B.P.C.'s current efforts in organising conferences and seminars on variety reduction. Moves were also being made in the introduction of more standards training in technical colleges which the B.P.C., B.S.I. and educational authorities were now discussing.

(*c*) *Implementation of standards*

Mr. R. B. Armstrong (*Marconi's Wireless Telegraph Co. Ltd.*) said that the question of ensuring that products made to British Standards were available was a fundamental one for these Conferences to tackle. A firm buying components was constantly frustrated by non-availability of products made to the standard and by the lack even of relevant knowledge among suppliers; frequently extra had to be paid for the product made to the standard instead of for the "special". He said that means must be found of disseminating information regarding those manufacturers who made in accordance with the standard, and felt that pressure from users on individual manufacturers could not solve the problem. He hoped that the B.S.I. could take some action to publish lists of suppliers in addition to the information issued on firms licensed to use the Kite mark.

(*d*) *Summary Sheets*

Mr. Weston said that new summary sheets related to B.S.916 (black bolts, screws and nuts) were on the point of publication and that B.S.I. were working on further sheets related to B.S.1769 (unified black hexagon bolts, screws and nuts and plain washers — heavy series) and B.S.2708 (unified black square and hexagon bolts, screws and nuts (UNC and UNF threads) and plain washers and normal series). The demand for the sheets already published was,

however, disappointing and the B.S.I. would be glad to receive comments on the usefulness of summary sheets and how they might be improved.

(e) Indexing of British Standards

Mr. Stafford recalled that the idea of a complete coding system for all component parts used in British industry had been considered by the I.Prod.E./B.S.I. Committee to be impracticable, but the Committee was anxious that the material available in British Standards should be traceable through a comprehensive index; among many instances of material which could not be found from the index of the British Standards Yearbook he instanced a limiting temperature for cast iron and an ageing test for rubber, the latter being found in a standard for safety gloves. To remedy this, the Committee had recommended adoption of a systematic card index covering a wide range of features in British Standards and B.S.I. was now examining the means of carrying out this recommendation. To complete the index would probably take about two years.

In reply to a suggestion that a national coding system for "hardware" would be a great convenience in purchasing, **Mr. Stafford** said that a national code would be too cumbersome; individual firms could more usefully apply their own codes, tailor-made to their particular requirements, the proper reference to the British Standard number being used to identify the item when it was being ordered.

Dr. E. L. Diamond (*B.S.I.*) suggested that in a limited field the B.S.I.'s summary sheets provided a national code number system — e.g., for fasteners.

CO-OPERATION BETWEEN STANDARDS, DESIGN AND PURCHASING DEPARTMENTS IN THE APPLICATION OF STANDARDS

Summary of Paper submitted

The question at issue is that of translating British Standards into terms of purchasing specifications or the particular design required for an installation, and how the firm through its various branches can make use of British Standards to the best advantage, with the related problem of how British Standards can be prepared and presented in a way which is of the maximum help in industry.

The problems which arise making standards are well-known, but there is much less information available on the difficulties which arise in using these standards, because no machinery exists to analyse their impact on industry at large. Some of the difficulties in getting specifications applied arise because practices have grown up around the use of proprietary materials. These are described in such a way that their basic make-up is not self-evident, and it therefore becomes time-consuming for the normal user to attempt to relate them to specifications in non-proprietary terms. Thus, very often, the effort required to relate British Standards to existing practices is not made, with the result that such standards are not used. There are also widely varying practices in the use of materials and components for similar duties, resulting in unnecessary variety.

Large organisations can overcome this by giving guidance on such matters in their own documents, but action at B.S.I. level may be required if support for standards from the large number of smaller organisations is to be fostered.

Ways and means should be considered by which the use of British Standards can be encouraged further. It is possible that data sheets may serve this purpose. For instance, a code for pressure piping systems could be supplemented by model data sheets showing service applications for common pipeline systems within groups of industries.

A Users' Association has examined its practices with regard to its application of British Standard B.S.1916 — "Limits and Fits for Engineering" — and has codified a number of common practices which could very well be taken as an example and amplified by data sheets for information of industry at large.

DISCUSSION

Mr. A. Parrish (*Imperial Chemical Industries Ltd.*) introducing the subject, said that in the course of the Conference, some aspects of it had already been discussed, and Mr. Armstrong in particular had dealt with the question of implementation. Last year's Conference had stressed that implementation of standards by manufacturers was conditioned by the users. The effective demand from users was, however, conditioned in turn by their knowledge and understanding of British Standards. Many firms ordered products by proprietary designations and did not recognise the same product, as specified in a British Standard. Mr. Parrish considered that there was some force in the criticism that British Standards were not easily understood, and urged that thought should be given to the provision of supplementary information, particularly for the benefit of small firms which had not the resources to study and interpret British Standards for the purpose of their company standards. Some British Standards did give some useful guidance but it was not always easy to find. The Paper before the Conference indicated examples of the supplementary data sheets he had in mind.

He also suggested that British Standards tended to be too exclusive in regard to end uses (e.g., the standard for sluice valves for waterworks which was virtually a standard for the water authorities) and an unnecessary multiplicity of standards was created. Mr. Parrish argued that to take steps, such as he had indicated, to secure a wider implementation of standards was important not only in the domestic field but in the international one, since it would be very damaging if we urged and secured the adoption in an international recommendation of the British Standard, only to find it was not used at home.

(continued at foot of next page)

REPORT OF THE MEETING OF COUNCIL

23rd July, 1959

THE first meeting of the Council of the 1959-1960 Session was held on Thursday, 23rd July, 1959, at 10 Chesterfield Street, Mayfair, London, W.1. Mr. R. H. S. Turner, Vice-Chairman of Council, presided in the absence on holiday of the Chairman, Mr. H. W. Bowen, O.B.E.

Before proceeding with the business of the meeting, which was attended by 27 members, the Chairman welcomed both the Immediate Past President, Lord Halsbury, and the new President, Mr. G. Ronald Pryor. He also welcomed all newly-elected members of Council who were attending for the first time, and those visitors who were present by invitation: Mr. J. Keightley, Honorary Secretary of the East and West Ridings Region; and Mr. P. Trosset, Chairman of the London Graduate Section.

Standing Orders of Council

On the motion of the Chairman, the Standing Orders, which had been previously circulated, were adopted for the current year. (Note: The Standing Orders have been established principally by Resolutions of Council over the years, and are submitted to the first meeting of Council each year, for alteration or rejection.)

Installation of President

The Chairman called on the Immediate Past President, The Rt. Hon. the Earl of Halsbury, to install the new President, Mr. G. Ronald Pryor.

Lord Halsbury said that it seemed only a very short time ago that Mr. E. W. Hancock had been installing him in office. At that time, he had said that his only promise would be to do his best, because no one knew what the job would involve. Looking back at all that had happened in the Institution in the past two years, he could not imagine how they had found time to do it all. It seemed to be the reverse of Parkinson's Law; the less time there was available, the more jobs were done!

During the past two years the Petition for the Grant of a Royal Charter had been launched. As President, Lord Halsbury had had to play his part in that. It fell to Mr. Pryor to follow this up, and he wished him the very best of luck in carrying it through to a successful conclusion. It was a great pleasure to install him in the office of President.

Mr. Pryor, in reply, said there had been conferred on him the greatest honour which the Institution could bestow. He would use every endeavour to justify the trust placed in him, and would try to be a

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FIFTH STANDARDS CONFERENCE—*concluded from previous page.*

SUMMING-UP

Mr. Mills, picking out some of the highlights of the Conference, referred first to Lord Halsbury's constructive opening address; his views were backed by great practical experience and deserved proportionate attention. Many points of interest had been raised: the need for standardisation of terminology and the importance of classification and coding which was the start of all standardisation; the training of new standards engineers in established Standards Departments; and the necessity to make standards more intelligible.

Mr. Bertram White's address had brought out some very valuable lessons — his company had shown extraordinary courage in carrying out its drastic rationalisation policy and other managements might learn from its example.

The B.S.I.'s report had shown the scope of B.S.I.'s international activities and he thought that its officials were able ambassadors of standards abroad.

The report of the work of the I.Prod.E. Standards Committee was a record of valuable aid to the progress of standardisation. The setting up of an Association of Standards Engineers would require much thought and hard work.

The Chairman thanked those present for their participation in the Conference and looked forward to their help over the next 12 months.

worthy ambassador for the Institution wherever the need arose. If he took his predecessor as mentor, he would perhaps have a better chance of being successful in the task he had been given to do.

Election of Standing Committees, 1959 - 1960

The Report on the Election of Standing Committees was adopted. (Details of the election appear on page 530 of this Journal.)

In reply to Mr. J. Winskill, who commented on the poor attendance at meetings of some members elected to Standing Committees in the past, the Chairman said he felt very strongly about the situation. If members were prepared to allow their names to be put forward for nomination to committees, they should regard it as a duty to attend meetings. A man should not submit himself for election merely to have his name put on a list and published in the Council Papers and the Journal; he should do it in order to further the work of the Institution, which he could do only by taking part in it.

Election of Section and Region Honorary Secretaries and Region Honorary Treasurers

The Council confirmed the election of Section and Region Honorary Secretaries and Region Honorary Treasurers.

Finance

The report on the Institution's finances, together with the proposed budget for 1959 - 1960, was adopted by the Council. It was noted that the excess of income over expenditure for the year ended 30th June, 1959, was slightly greater than had been budgeted.

Secretary's Overseas Tour

It was reported by the Finance and General Purposes Committee that arrangements were being made for the Secretary to visit India, Australia and South Africa. He would leave the United Kingdom in January, 1960, and would be away for approximately three months. While the Secretary was in Australia, he would attend the 12th International Management Congress at Sydney and Melbourne.

Summer Meeting, 1960

Further to the report to the previous Council meeting that arrangements were being made for an Institution Social Function, to be held at the Royal Festival Hall on 27th June, 1960, the Finance and General Purposes Committee now proposed that this event be called an Institution Summer Meeting. It would commence at 2.30 p.m., when two Papers would be given — the Presidential Address and a Named Paper — followed by the social function in the evening.

Symposium on Machine Tool Development

It was reported by the Finance and General Purposes Committee that plans were being made for a residential conference to be held at the College of Aeronautics, Cranfield, dealing with developments in machine tools. This meeting would probably take place in the late Summer of 1960.

Region and Section Honorary Secretaries Conference

It was reported that the Annual Conference of Region and Section Honorary Secretaries was held at Headquarters on 27th May, 1959. The meeting was attended by 27 officers, and much useful discussion took place.

Production Engineering Research Association

Approval was given to the Finance and General Purposes Committee's recommendation that the Council should place on record the Institution's gratification at the steady progress of PERA, from its original foundation as the Research Department of the Institution; and that its views with approval the present plans for the future expansion of PERA.

Membership Subscriptions under Deed of Covenant

It was reported that the Board of Inland Revenue had now reviewed the question of membership subscriptions paid under Deeds of Covenant, and the outstanding claims of the Institution had been admitted. Now that the Income Tax regulations allowed members to claim refund of tax from their annual subscriptions, the Covenant Scheme would be dropped.

British Conference on Automation and Computation (Group C)

The Council approved a recommendation by the Finance and General Purposes Committee that, in common with the other Institutions or Associations who are members of the Group, the Institution should agree to make a payment of £100 should a loss be sustained on the 1961 National Conference to be held in Great Britain.

The Conference was being planned for an estimated attendance of 1,000 and if this was achieved, it was not envisaged that any loss would accrue.

Membership

The Council approved a number of applications for membership and transfer, details of which appear on pages 531 - 532 of this Journal.

Education

It was reported that the main work of the Education Committee since the last Council Meeting had been consideration of individual College and University courses, both in the United Kingdom and overseas, for exemption purposes. It was gratifying to report that Trinity College, Dublin, proposed to present a course leading to the B.A.I. Degree in Production Engineering.

Annual Summer School

Mr. J. France, Chairman of the Education Committee, reported that the Summer School had now been running for nine years. In the early years, it had been well supported, but recently attendance

had been declining. In the current year, lack of support meant that the School planned for 26th - 30th August would be cancelled.

While noting this with regret, the Council agreed that the fall in attendance reflected a national trend in regard to meetings of this nature.

Associates

It was reported by the Membership Committee that consideration had been given to the interpretation of the Article of Association governing the Associate grade of membership. The Chairman of the Committee would shortly be writing to all Sections on this matter.

The Journal

It was reported that the Editorial Committee's recommendations regarding future Journal policy, and their proposals for changes in layout and presentation, had now been approved by the Finance and General Purposes Committee, and would be brought into effect progressively from January, 1960. The Committee wished to acknowledge the helpful comments and suggestions received from Sections while the matter was under discussion.

The Committee were also pleased to report that the supply of material for publication was being maintained, and it was becoming possible to p'an ahead to a much more satisfactory extent than hitherto. Attention was particularly drawn to the publication of correspondence in the Journal, which it was felt, with a little support from members, could be developed into a feature of interest to all readers.

Institution Papers

The following report was received from the Papers Committee :

The 1958 George Bray Memorial Lecture. A most successful meeting was he'd at the Royal Commonwealth Society, London, on 29th April, 1959, when Mr. Mark Bogod, Director of J. Lyons & Co. Ltd., presented a Paper on "The Search for Productivity in a Food Industry". Mr. G. Ronald Pryor, then President-Elect of the Institution, occupied the Chair and a full report of the meeting appeared in the July issue of the Journal.

The 1959 Viscount Nuffield Paper. Arrangements have now been made for this Paper to be presented by Dr. C. Timms, M.I.Prod.E., Head of the Mechanisms, Metrology and Noise Control Division of M.E.R.L., East Kilbride. The meeting will take place in the Lecture Hall of The Institution of Shipbuilders and Engineers, Glasgow, on 17th March, 1960, the subject being "Recent Developments in Spur and Helical Gears". The Chair will be occupied by the President, Mr. G. Ronald Pryor.

The 1961 Viscount Nuffield Paper. Sir Willis Jackson, Director of Research and Education, Metropo'itan-Vickers Electrical Co. Ltd., has accepted the Institution's invitation to present this Paper in the Spring of 1961, taking as his subject the problem of maintaining and increasing the supply of skilled labour, both long and short-term.

Institution Medal Awards. The Committee's recommendations in regard to the Institution Medal Awards, which were unanimously adopted by the Council, were as follows :

Medal for the best Paper presented by a member and also *The Hutchinson Memorial Award for the best Paper presented by a Graduate* to Mr. A. J. Lawrance (now A.M.I.Prod.E.), for his Paper "The Application of Spark Erosion Machining".

Medal for the best Paper presented by a non-member to Dr. J. E. Littlechild, of the United Kingdom Atomic Energy Authority, for his Paper "Production Problems Associated with Industrial Atomic Energy".

The J. D. Scaife Medal Award jointly to Professor N. A. Dudley, M.I.Prod.E., of the University of Birmingham, for his Paper "Output Pattern of Repetitive Tasks, with special reference to compensating relaxation allowances" ; and to Mr. W. J. Kease, of E.M.I. Ltd., for his Paper "Computer-control'ed Machine Tools".

National Conference, 1960. The Papers Committee were now forming their Organising Committee for the Conference on "Modern Trends in the Manipulation of Metals", and the first meeting was being planned to take place at the end of September, 1959.

Promotion of Papers. In addition to assessing Papers received from Sections and Regions, the Papers Committee have commissioned for publication in the Journal comprehensive reviews on two subjects of extreme interest to production engineers :

(a) a review of developments in copy turning;
(b) a review of current practice in fine boring of steel, ferrous and non-ferrous materials.

Research

The following reports were received from the Research Committee, on behalf of its Sub-Committees :

Materials Handling. The Group Committee's main activity during the quarter has been to investigate ways and means of increasing Section activity and also methods of increasing membership of the Group. Proposals for widening the field of membership are being prepared for consideration by the Research Committee.

The final report of the Study Group working with the Building Research Station on "Co-ordination Between the Production Engineer and the Building Designer" is nearing completion.

Materials Utilisation. The Sub-Committee's report is to be published in September, 1959.

Control of Quality. In conjunction with the British Productivity Council and The Institution of Engineering Inspection, a successful Conference was held at Buxton in June, 1959. The Papers presented were of an extremely high standard and considerable interest was aroused not only amongst the 160 delegates, but also in the Press.

The Conference was fortunate in having the President-Elect, Mr. G. Ronald Pryor, to give the opening address, and the President of The Institution of Engineering Inspection, Sir Frederick Wrisberg, to close the proceedings.

The Control of Quality Sub-Committee is also represented on the British Productivity Council Advisory Committee, which is organising a European Conference on Quality Control to be held in London in 1960.

Co-ordination of Production Management Techniques. Steady progress is being made with the report of this Sub-Commitee, and a number of new members have been co-opted.

Computers and Production Control. Members of the Sub-Committee are working on various sections of the report and it is hoped that rapid progress will be made during the next few meetings.

Terms of Reference. New terms of reference for the Research Committee have been discussed and submitted to the Ad Hoc Committee on Organisation.

Standardisation

It was reported by the Standards Committee that the Sub-Committee on International Standards has made progress with its work of reading and preparing comments on the implementation of International Standards Recommendations.

The Sub-Committee on Unit Heads and Platens has circulated to industry various enquiries on the question of standardisation of machine tool limit switches, in order to formulate proposals for submission to the British Standards Institution.

The fifth Annual Conference for Standards Engineers, organised by the Joint I.Prod.E./B.S.I. Standing Advisory Committee on the Use of Standards in Industry, was held on 4th June and once again proved to be highly successful, attracting an attendance of some 250. (A report appears on pages 518 - 526 of this Journal.)

In addition to the British Standards Institution, the Standards Committee continues active liaison with the National Joint Committee on Non-Destructive Testing; the British Institute of Management; and the British Productivity Council.

The Library

It was reported that the Library Committee had considered the various suggestions put forward at the last Council meeting, on the possibility of extending the Library Committee's activities. It was agreed that the Committee should undertake some work in connection with the history of production engineering, in particular to record significant advances in techniques. A sub-committee had been formed to study ways and means of tackling this project, and would shortly report back to the parent Committee.

Region and Section Quarterly Reports

The Council received a number of Quarterly Reports from Regions and Sections.

Liaison with Sections outside the United Kingdom

The Chairman, reporting on this item, said that most overseas Sections had expressed gratification at the postponement for 12 months of the new subscription rates. There was general appreciation of the necessity for raising the subscriptions.

Overseas Sections had also expressed approval of the Membership Committee's power to take a broader view of the qualifications for Associate Member. The Canadian Committee had submitted a detailed memorandum on present and future educational facilities in Canada, particularly in relation to the Institution's examination requirements. This document was now being studied by the Education Committee.

Mr. Nicholson, Honorary Treasurer of the Canadian Section, would shortly be visiting Headquarters, and would discuss these and other matters.

In the educational field, the Institution's President had recently given a dinner for Professor Thacker, Secretary for Cultural and Scientific Affairs for the Government of India, which had been attended by the Principal Officers and the Immediate Past Chairman of the Education Committee. Arising from this meeting, where there had been considerable discussion of the problems of education and training of production engineers in India, it was probable that the Government of India would invite the Institution to send a small advisory team to India. It was hoped that this team would be led by Sir Walter Puckey.

From Bombay, the retiring Chairman, Mr. Shah, reported that interest and attendance at meetings had been sustained at a high level, and attributed this in no small measure to the hard work and enthusiasm of the Section Secretary, Mr. C. R. Pal.

The Melbourne Section had asked the Chairman to remind Council that any member visiting Australia would be welcomed at any Institution functions there; if necessary, special meetings would be arranged to enable visitors to meet their fellow members.

The overseas Sections were keeping closely in touch with Headquarters and expressed the keenest appreciation of all the information sent to them, and of the way in which they were kept informed of all that took place in Council and in Committee.

Ad Hoc Committee on Organisation

Considerable discussion took place on the Report of the Ad Hoc Committee on Organisation, which had been circulated to members of Council in advance of the meeting.

The Chairman, who had also acted as Chairman of the Ad Hoc Committee, emphasised that the Report did not make any sweeping recommendations. It rather accepted that the organisation set up under the terms of the Burke Committee had, by and large, been operating very successfully. But the Ad Hoc Committee did make certain recommendations which it felt would ease and in certain respects improve the operation of the Institution.

After discussion by the Council, it was agreed that the Report be referred to Region, Section and Standing Committees for criticism and comment, which should be submitted to Headquarters by not later than 29th December, 1959. These opinions, together with the recommendations of the Ad Hoc Committee, will be considered at the January, 1960, Council Meeting, and will be ratified at the April, 1960, Council Meeting.

Honours

The Council were pleased to learn that Her Majesty the Queen had conferred the following awards on members of the Institution:

Knight Bachelor

James Reginald Pearson.

C.B.

R. Ratcliffe, M.B.E.

C.B.E.

Brigadier S. R. W. Clarke, R.E.M.E.;
E. Wheeldon.

B.E.M.

E. R. Booth.

Obituary

The Council learned with great regret of the deaths of the following members:-

Members: F. J. Bates; A. T. Holman; J. L. Jameson; C. S. Noble; C. L. Taylor.

Associate Members: M. W. Alderdice; J. Brook; F. L. Dony; B. Leitch; S. K. Mukherjee; T. Wrigley.

Associate: A. Brown.

Student: A. J. Murrell.

Date and Place of Next Meeting

It was agreed that the next meeting of the Council should take place on Thursday, 29th October, 1959, at 11 a.m., at 10 Chesterfield Street, Mayfair, London, W.1.

THE STANDING COMMITTEES, 1959/60

At the meeting of the Council held on 23rd July, 1959, the following were elected to serve on the Institution's Standing Committees for the year 1959 - 60:

Finance and General Purposes Committee

The Principal Officers:-

The President: Mr. G. Ronald Pryor.
The Vice-President: Mr. H. Burke.
The Chairman of Council: Mr. H. W. Bowen, O.B.E.
The Vice-Chairman of Council: Mr. R. H. S. Turner.
The Immediate Past Chairman of Council: Mr. H. G. Gregory.

Elected Members:

W. H. Bowman	J. France	R. E. Leakey
E. Percy Edwards	R. W. Hancock	A. L. Stuchbery

The Chairmen of all Standing Committees — Editorial, Education, Hazleton Memorial Library, Membership, Papers, Research and Standards, are ex-officio members of the Finance and General Purposes Committee.

Education Committee

The Principal Officers

W. Ainslie	A. A. Jacobsen	E. Walshaw
J. H. Devonald	M. G. Page	C. A. Whitford
E. Percy Edwards	J. F. Smith	B. Whittaker
J. France	B. E. Stokes	
K. J. Hume	R. J. Sury	

Membership Committee

The Principal Officers

A. Betts Brown	K. J. Hume	J. A. W. Styles
W. M. Buchan	E. G. Kinch	K. E. Taylor
G. H. Crump	T. F. Newton	A. C. Turner
R. Dent	R. D. Owen	R. Wheeler
E. Percy Edwards	H. Spencer Smith	B. Whittaker

Editorial Committee

The Principal Officers

J. Mitford Brice	J. C. Z. Martin	B. E. Stokes
H. Peter Jost	M. J. Sargeaunt	

Papers Committee

The Principal Officers

F. C. Cooke	A. A. Francis	H. J. C. Weighell
H. J. Elton	J. C. Z. Martin	G. Wittenberg

Research Committee

The Principal Officers

L. W. Bailey	R. K. Grunau	S. G. E. Nash
J. G. Collyear	J. L. Gwyther	J. G. Noble
G. Deane	K. J. Hume	A. P. Oppenheimer
Prof. N. A. Dudley	B. G. L. Jackman	W. B. Pamment
T. W. Elkington	Prof. J. Loxham	J. J. Peck
F. G. S. English	H. W. Mander	F. E. Rattlidge
R. M. Evans	Dr. T. U. Matthew	

Standards Committee

The Principal Officers

B. H. Charman	R. E. Mills	H. Stafford
D. B. Ebsworth	R. V. Rider	C. M. P. Willcox
J. Harris	B. A. J. Rule	J. H. Winskill
Prof. J. Loxham	T. A. C. Sparling	W. E. Wright

Hazleton Memorial Library Committee

The Principal Officers

C. L. Aslen	R. V. Rider	J. D. Smith
L. W. Bailey	M. J. Sargeaunt	S. R. Smith
J. Isaacs	The Lord Sempill, A.F.C.	R. J. Temple
H. L. Madeley		

ELECTIONS AND TRANSFERS

23rd July, 1959

BIRMINGHAM SECTION

As Associate Member
W. Tearne.
As Associates
P. A. Cartwright; F. W. Newell.
As Graduates
P. J. McCarthy; J. E. Bland; M. W. Fairey; G. L. Johnston; M. R. Hancock; J. A. Burton; A. H. Watkiss; J. A. Anderson; I. D. Nussey; A. G. Smith; B. J. Harris; B. M. Burdett; T. Newman
As Students
K. W. Malkin; B R. Salisbury; A. T. Yates; J. R. Commander; C. F. Bassford; D. B. Austin; R. D. Ham; R. B. Clark; D. H. Burns; J. W. Hands; B. A. Jackson; M. R. L. Daniel.
Transfers
From Graduates to Associate Members
C. R. Lappage; A. W. Markham; E. J. Lownes; R. C. Worrall; G. L. Allen.
From Students to Graduates
P. Fineman; A. H. Smith.

BOMBAY SECTION

As Graduates
R. H. Patel; B. Bansal.
As Student
T. S. Nair.
New Affiliated Firms
Harshadray Private Ltd.; Shishir & Co.
Transfers
From Students to Graduates
P. K. Tikku; A. D. Patel.

CALCUTTA SECTION

As Graduates
S. K. Khanna; T. K. Chaudhuri.
As Student
V. Chakrabarti.

CANADA SECTION

Transfer
From Graduate to Associate Member
A. J. Hutton.

CARDIFF SECTION

As Associate Member
J. Owens.
As Graduates
G. Hann; N. Parry; R. Beddoe.
As Students
R. J. Edwards; F. B. Cockram; C. Isaac; B. J. Strutt; W. J. Thomas; D. J. Phillips; M. A. Powell; G C. G. Knott; R. Evans; J. Nicholls G. R. Jones; G. D. Morgan; B. O'Hanlon; D. J. Rees; A. Williams; P. S. Samuel; E. J. Woollard; H. Jones.
Transfers
From Associate to Member
C. J. Williams.
From Graduate to Associate Member
S. W. Orr.
From Student to Graduate
D. G. Davies.

COVENTRY SECTION

As Associate Members
J. D. Snow; L. J. Miles; A. R. Hyslop; J. Killingback; S F. Shearman.
As Graduates
N. Tarver; G. Adler; A. J. Aldridge; C. Wyatt; K. R. Barker; B. S. Symonds; T. Wyatt; V. L. Lee; K. Mitchell; R. Vose.
As Students
A. J. Wade; Miss E. A. Golby.
Transfers
From Graduates to Associate Members
D. A. Reynolds; A. T. H. Selby; J. A. Loudon.
From Student to Graduate
P. J. Norburn.

DERBY SECTION

As Associate Member
C. G. W. Betts.
As Graduates
C. A. W. Wells; N. B. Watts; M. J. Kelk; J. B. Foster; M. C. Butcher.
As Students
A. H. Sharpe; J. Sinnott.
Transfers
From Graduates to Associate Members
M. H. Donbavand; A. R. Wareing; R. Sampson.

DUNDEE SECTION

As Graduates
S. Webster; R. Copestick.

EDINBURGH SECTION

As Student
J. C. Patel.

GLASGOW SECTION

As Associate Member
T. D. Lockhart.
As Graduate
D. Fenton.
As Students
W. McLinton; J. L. McIlroy.
Transfers
From Graduates to Associate Members
T. H. Thomson; T. Kirkpatrick.

GLOUCESTER SECTION

As Graduates
D. B. James; B. T. Smith; H. Hindle.
As Students
L. J. Gulliford; E. A. Everett.
Transfers
From Associate Member to Member
N. S. Payne.
From Student to Graduate
P. D. Ounsworth

IPSWICH & COLCHESTER SECTION

As Students
D. C. Butcher; H. T. Ong.
Transfer
From Student to Graduate
C. Stratford.

LEEDS SECTION

As Member
J. Parker.
As Graduates
H. M. Thomas; J. F. Denton; E. Wheatley; A. K. Das Gupta.
As Students
E. Ratcliffe; C. Ackroyd.
Transfers
From Graduates to Associate Members
P. M. Porter; W. Shelton; H. G. Lamb; D. Rose.

LEICESTER SECTION

As Graduates
D. G. Harris; B. W. Frost; J. B. Carter.
Transfers
From Associate Member to Member
H. S. Hughes.
From Graduate to Associate Member
W. G. A. Vaizey
From Student to Graduate
J. S Hawkins.

LINCOLN SECTION

As Associate Member
J. R. Bradshaw.
As Graduate
D. T. Brant.
Transfer
From Student to Graduate
J. A. Rose.

LIVERPOOL SECTION

As Associate Member
R. While.
As Graduates
F. W. Mooney; P. N. Kirkbride.
As Students
R. E. L. Seal; N. M. McDonnell.
Transfers
From Graduate to Associate Member
D. J. Foster.
From Student to Graduate
R. R. Cottrell.

LONDON SECTION

As Members
D. M. K. Marendaz; D. H. A. Mackenzie; J. R. Parsons.
As Associate Members
E. L. R. Watt; R. S. Butler; P. J. Bridges; J. A. C. Williams; J. G. Elliott.
As Graduates
R. L. Greenhall; R. J. Kirk; J. C. Darley; V. H. G. Selwood; R. K. Gladwin; D. C. Lockington; D. Bexley; M. E. Rice; R. J. Osborne; A M. Throp; L. E. Green; H. R. J. Hoare; K. Newstead; J. E. Soloman; G. W. Thornton; D. A. Farrant; F. E. Coniam; P. O. V. Lewis; R. Kelly.
As Students
W. B. Hart; R. H. Stubbs; B. A. Shepherd; D. C. Hayes; R. J. Oughton; D. R. Dew; J. R. Garlick; M J. Bourbery; S. K. Soni; D. M. Fisher; D. R. Snipper; B. C. Wright; W. H. Adams; D. G. C. Dunster; J. J. A. Jarvis; B. E. White; P. D. Robinson; I. T. Hunter; R. E. Hogben; M. Bunker; E. R. Fielding; A. E. Lindsay; D. J. B. Breeze.
Transfers
From Graduates to Associate Members
G. G. Fenton; L. W. Frost; M. B. Brown; R. T. Vickers; P. S. Langton; V. E. Judge; J. L. Blumire; R. A. Schooley; J. Malcolm; S. L. A. Corder; J. A. Harris; P. H. Banks; R. S. Nicholas; W. S. Forster; H. F. Lowe; J. E. Weatherley; R. L. Whitley; P. J. Dewsnap; P. H. Sturgess.
From Students to Graduates
J. F. Belt; T. J. Kelly; I. F. Spedding; G. A. Milne; C. E. Leeder; J. B. Ranson; A. Baxter; M. Harding; D. J. Briggs.

LUTON SECTION

As Associate Member
R. V. Page.
As Graduates
D. A. Fisher; R. M. Pedley; J. B. Farrow.
As Students
D. N. Williamson; R. A. Oliver; W. S. Lane.
Transfers
From Graduate to Associate Member
R. J. Forward.
From Students to Graduates
D. R. Munt; D. R. Summerson.

MANCHESTER SECTION

As Associate Member
M. P. Rubert.
As Associate
P. M. Burman.
As Graduates
M. Chadwick; J. P. Falor; M. K. Ghosh; E. J. Blackwood; W. J. Wills-Moren; S. P. Prashar.
As Students
D. M. Lang; R. Raizada; B. C. Shaw; P. H. Starkey; F. Hilton.
Transfers
From Associate Members to Members
D. C. Baird; F. J. Cordwell.
From Graduates to Associate Members
V. J. Crowsley; A. C. Bell; W. M. Rimmer; J. R. Thompson.

MELBOURNE SECTION

As Member
A. M. Dyson.
As Associate Members
N. W. Stanford; L. R. Harrison; C. G. Luxton.
As Graduates
R. B. Johnston; C. G. Evans.
New Affiliated Firms
Ford Motor Co. of Australia Pty. Ltd.; Heine Bros. (Aust.) Pty. Ltd.
Transfers
From Associate Member to Member
F. J. Chalmers.
From Graduates to Associate Members
A. E. Norris; K. A. James.
From Student to Graduate
J. S. Baker.

NEWCASTLE UPON TYNE SECTION

As Graduates
R. Clarke; E. D. Watson; D. T. Roberts; G. Gerner; P. Cummings.
As Students
N. Whitley; A. G. Pickering.

NEW ZEALAND SECTION

As Graduate
R Hood.

NOTTINGHAM SECTION

As Member
G. F. Gledhill.
As Associate Members
E. J. Swinn; H. F. Simmons.
As Student
G. Gibson.

OXFORD SECTION

As Member
A. G. H. Oxley.
Transfer
From Graduate to Associate Member
A. S. C. Barker.

PETERBOROUGH SECTION

As Graduate
H. Hassan.

PRESTON SECTION

As Associate Member
A. O'Donoghue.
As Graduates
B. Fletcher; M. Whiteoak; E. L. Bibby; D. Hall; S. Higgon; A. K. Sinha.
As Students
D. S. Wood; C. B. Golding; T. Lowe.

READING SECTION

As Graduate
J. W. Raffel.
As Student
I. J. D. Roberts.
Transfers
From Graduates to Associate Members
J. D. Parson; K. H. Davies.

ROCHESTER SECTION

As Associate Member
K. D. C. Smith.
Transfer
From Student to Graduate
D. B. Hurst.

SHEFFIELD SECTION

As Associate Member
J. A. Saunt.
As Graduate
R. Barton.
Transfers
From Associate Member to Member
J. G. Noble.
From Graduates to Associate Members
D. Dawson; F. Whitaker.

SHREWSBURY SECTION

As Associate Member
A. E. Spiers.
Transfer
From Associate Member to Member
G. Deane.

SOUTH AFRICA SECTION

As Associate Members
D. E. Foote; J. G. Bulteel.
As Students
J. H. Verster; W. T. Longhurst.
Transfers
From Associate Member to Member
C. J. Mogford.
From Graduate to Associate Member
W. S. Whitecross.

SOUTH ESSEX SECTION

As Graduates
B. R. Simmonds; A. G. Holmes; J. B Jackson.
As Students
L. B. Cox; C. G. Witney; R. G. T. Cook
Transfers
From Graduates to Associate Members
R. F. Jones; R. A. Shrubsole.
From Student to Graduate
J. R. Wray.

SOUTHAMPTON SECTION

As Graduate
C. W. Hicks.
As Student
V. P. Moores.

STOKE-ON-TRENT SECTION

As Associate Member
C. Kirkham.

SWANSEA SECTION

Transfer
From Student to Graduate
G. R. Thomas.

SYDNEY SECTION

As Graduates
G. M. Williams; R. T. Le Platrier; N. K. Harris.
Transfers
From Graduates to Associate Members
A. Brack; D. Richmond; T. Thompson.

WESTERN SECTION

As Associate Member
B. Baxter.
As Graduates
J. W. King; B. K. Saunders; J. R. Calder; M. M. Murray.
As Students
D. W. Eggbeer; J. A. Hobbs; J. D. Beckett; R. J. Lancastle; D. P. Matthews.
Transfers
From Graduates to Associate Members
L. M. Harman; J. R. Hawkins.
From Graduate to Associate
R. Prescott.
From Student to Graduate
C. D. J. Parker.

WOLVERHAMPTON SECTION

As Member
J. L. Brockhouse
As Associate Member
D. G. Hutton.
As Graduates
W. H. Baugh; G. L. Preston; D. C. Lanfear.
As Students
T. Chadwick; B. Cavanagh; K. B. Nicholls; J. B. Clifford.
Transfers
From Graduates to Associate Members
F. W. Smith; D. T. Amos; S. F. Ling.
From Student to Graduate
E. Sutton.

WORCESTER SECTION

As Graduates
M. S. Chatwin; S. Carrington.
Transfers
From Graduates to Associate Members
H. G. Deboo; J. W. Smith.

NO SECTION

As Members
C. H. M. Dolezalek; W. Eccles.
As Associate Member
V. G. H. Tandy.
As Graduates
M. S. F. Croissant; J. B. Clarkson.
As Students
R Wander; T. L Wiseman.

B.I.M. NATIONAL CONFERENCE, 1959

The 1959 B.I.M. National Conference will be held at Harrogate from 17th - 19th November. The opening address will be given by the United States Ambassador, Mr. John Hay Whitney, and the closing address by Lord Shawcross.
Among the other speakers will be : Dr. Mark Abrams; Mr. H. A. R. Binney, C.B.; Mr. J. A. Birch; Mr. C. F. Brook; Mr. C. T. Brunner; Professor Norman C. Hunt; Mr. H. E. Roff; Mr. B. Ungerson; Mr. P. H. D. Ryder; Lord Shackleton; and Miss N. Seear.

Further details and applications forms may be obtained on application to The Conference Secretary, British Institute of Management, 80 Fetter Lane, London, E.C.4.

news of members

Mr. S. E. Blackstone, Member, is now Chief Industrial Adviser to the Industrial and Commercial Finance Corporation, Limited. It was incorrectly reported last month that Mr. Blackstone was General Manager of the Corporation.

Professor John Loxham, Member, Head of the Department of Aircraft Economics and Production at The College of Aeronautics, Cranfield, left the U.K. last month to visit Australia and the U.S.A. During his stay in Australia, members at Melbourne and Sydney will have the opportunity of hearing Professor Loxham present a Paper on "The Control of Quality in Engineering Production".

Mr. Stephen Smith, Member, has recently relinquished his position of Works Manager of Electroflo Meters Co. Ltd., London, to take up an appointment as Works Manager with Townson & Mercer Ltd., Croydon.

Mr. O. W. Dokk-Olsen, Associate Member, has left Hayward Tyler & Co. Ltd., to take up an appointment as Senior Methods Engineer at English Electric Aviation Ltd., Luton.

Mr. D. H. Goss, Associate Member, is now Works Manager of Ewart Chainbelt Co. Ltd., Derby.

Mr. R. Pattinson, Associate Member, has joined the Sales Staff of Messrs. Stuart Davis Ltd., in the capacity of London Area Manager. He took up his new appointment on 1st August, 1959. For the past 30 years Mr. Pattinson has represented Messrs. Wickman Ltd., in the London area.

Mr. S. D. Hollander, Graduate, left for America on 5th August to fulfil his Schofield Scholarship tour of three months in America. He is photographed here with Mr. R. N. Barton, Director of Production-Engineering Ltd., where Mr. Hollander is employed in the Technical Division, and Mr. H. W. Bowen, O.B.E., (right) Chairman of Council of the Institution, immediately before departure from Waterloo.

During his tour, Mr. Hollander will be concerned with the study of handling methods in the warehousing, packaging and engineering industries over as wide a field as possible. He intends to visit selected companies in New York, Chicago, Philadelphia and Cleveland, as well as — it is hoped — attending materials handling analysis and research courses at one of the universities.

Mr. A. S. Sault, Associate Member, is now Works Manager of John Thompson Ordnance Company.

Mr. R. Harvey, Graduate, is now Assistant Chief Engineer — Quality Investigation Department, The Rover Co. Ltd., Solihull.

Mr. V. Selwood, Graduate, who was Junior Draughtsman at C.V.A. Jigs Moulds Tools Ltd., Hove, has taken up an appointment as Quality Engineer with Rolls-Royce Ltd., Derby.

Mr. A. B. Shepherd, Graduate, has recently taken up an appointment as Production Engineer with Messrs. Edward Wilcox & Co. Ltd., Wythenshawe, Manchester.

Mr. K. V. Stanely, Graduate, is now Works Manager of The Chiswell Wire Co. Ltd., Watford.

CORRESPONDENCE

From: **Mr. D. W. Edwards,**
Chairman,
Birmingham Graduate Section.

GRADUATE PAPERS

MR. Peter Spear's letter which was published in the June issue of the Journal was noted with interest by members of the Birmingham Graduate Committee.

The Papers Sub-Committee to which he referred is still in existence in Birmingham, and it is anxious to assist Graduate and Student members in the preparation and illustration of Papers for presentation to the Section. We are fortunate in being able to call on the advice of two members of the Senior Committee, who have freely offered their assistance in this connection. Any Student or Graduate member in the Birmingham Section who would like to present a Paper to the Section is invited to contact the Graduate Section Secretary, when a meeting with the Sub-Committee can be arranged to discuss his proposals in an informal and friendly way.

In recent years, a Graduate Papers evening has featured in our programme at which five or six short Papers (10 - 15 minutes) have been presented. These have been eligible for the award of the Senior Chairman's Prize. It is surprising how interesting it is for members to hear of activities which may be considered as matter-of-course by their fellows. Furthermore, a feeling of good-natured competition is engendered which makes for a most stimulating evening. Those who have already come forward to speak can heartily endorse Mr. Spear's conclusion regarding the value of the personal effort in preparation and delivery of a Paper as an important contribution to general training.

We are now attempting to arrange for two Papers of about 45 minutes duration to be presented at an evening lecture meeting and would welcome approaches from members.

It is of interest to note that during the last session (1958 - 59) two full-length Papers were presented by Graduate members in Birmingham. In the previous session, one Graduate member presented a full-length Paper which was subsequently published in the Journal.

In the experience of this Committee, it has been found that a personal approach by a Committee member has been the most successful way of enlisting prospective authors. However, this should not deter a prospective author from taking the initiative — the Papers Sub-Committee is only too anxious to assist.

DIARY DATES FOR 1959

September 24th - 25th — **Eastern Regional Conference, Norwich.**
Theme : **"Production Engineering as a Function of Management."**

October 12th ... ... — **The 1959 E. W. Hancock Paper,** to be presented in Bristol.
Speaker : **Mr. R. A. Banks,** Personnel Director, Imperial Chemical Industries Limited.
Subject : **"Human Relations in Industry."**

November 19th ... — **The Annual Dinner,** Dorchester Hotel. London, W.1.

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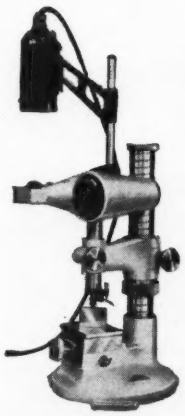

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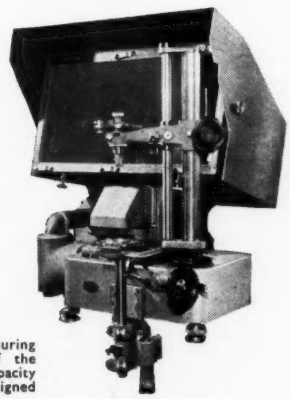

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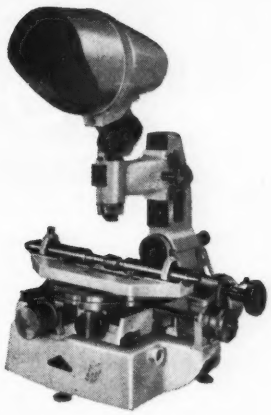

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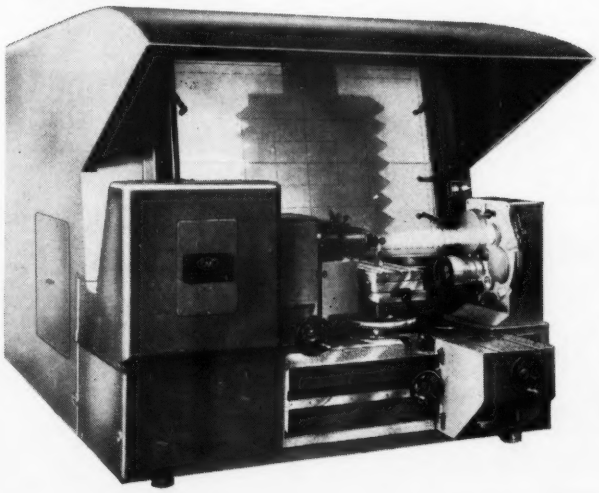

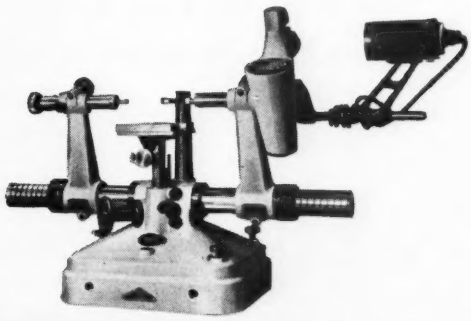

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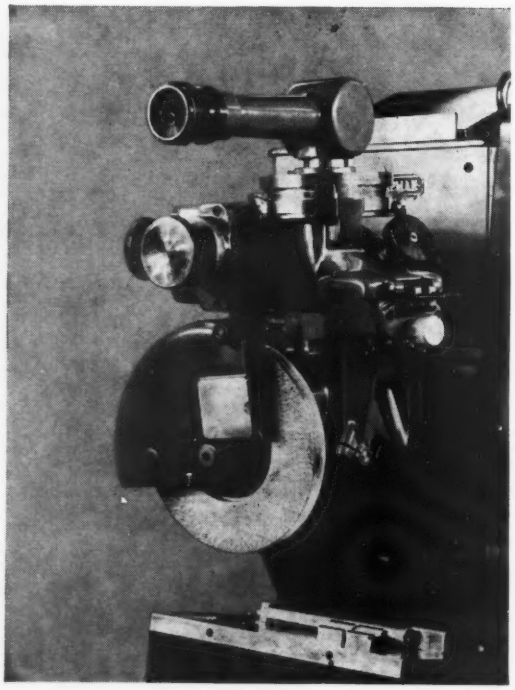

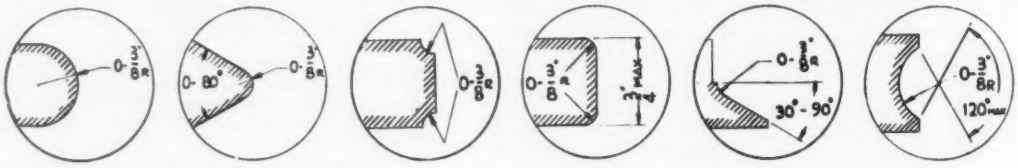

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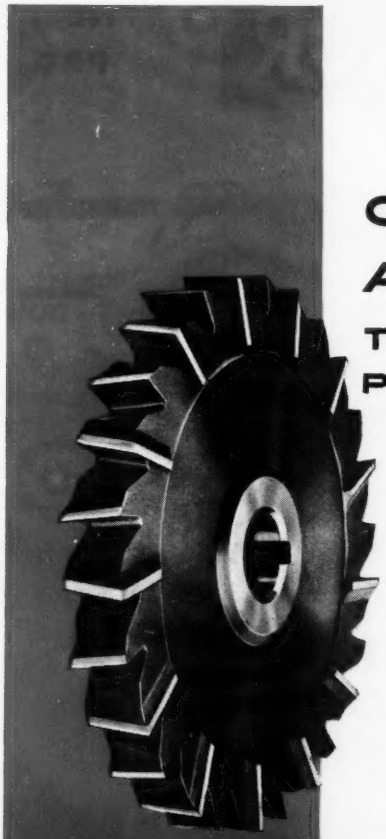

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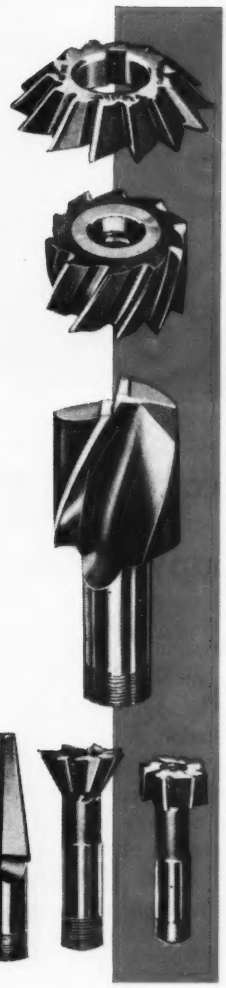

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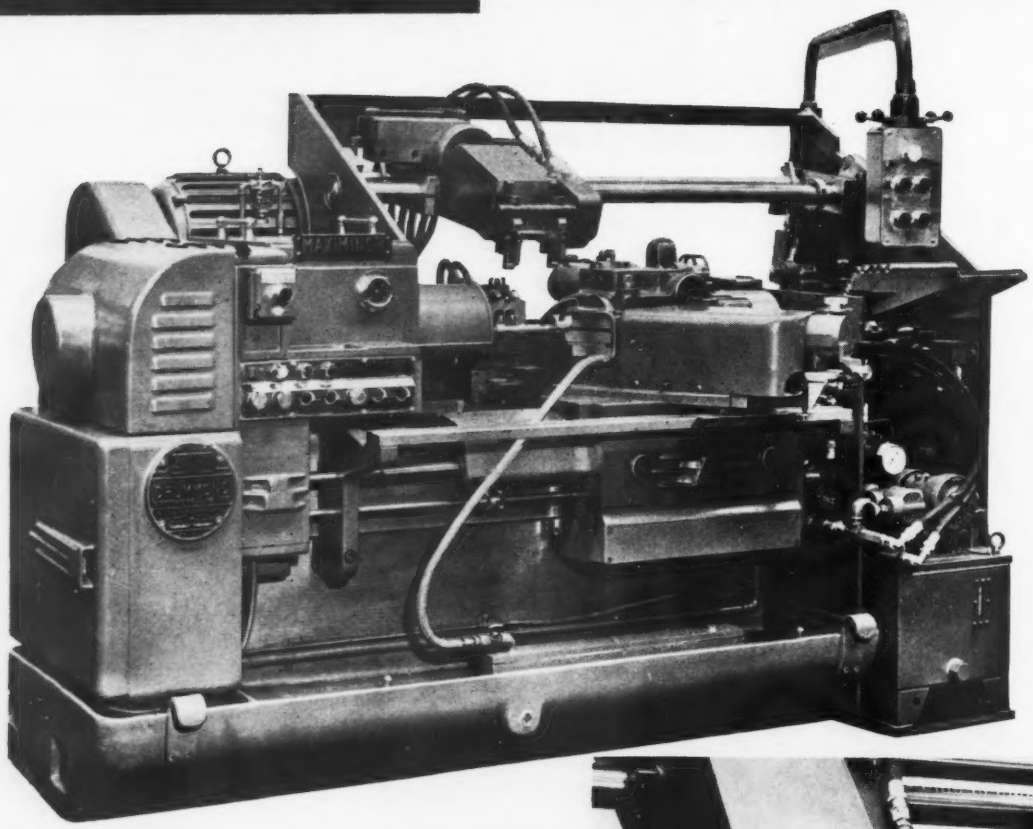

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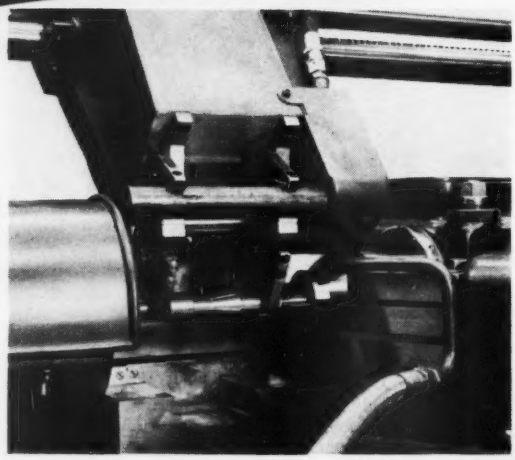

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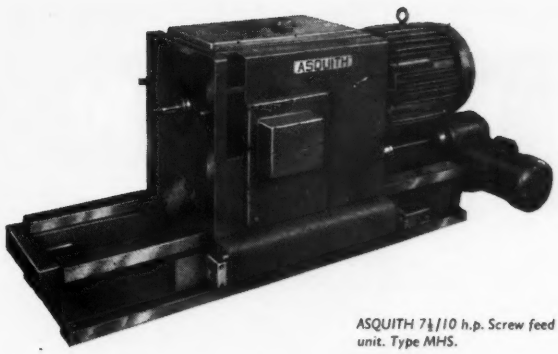
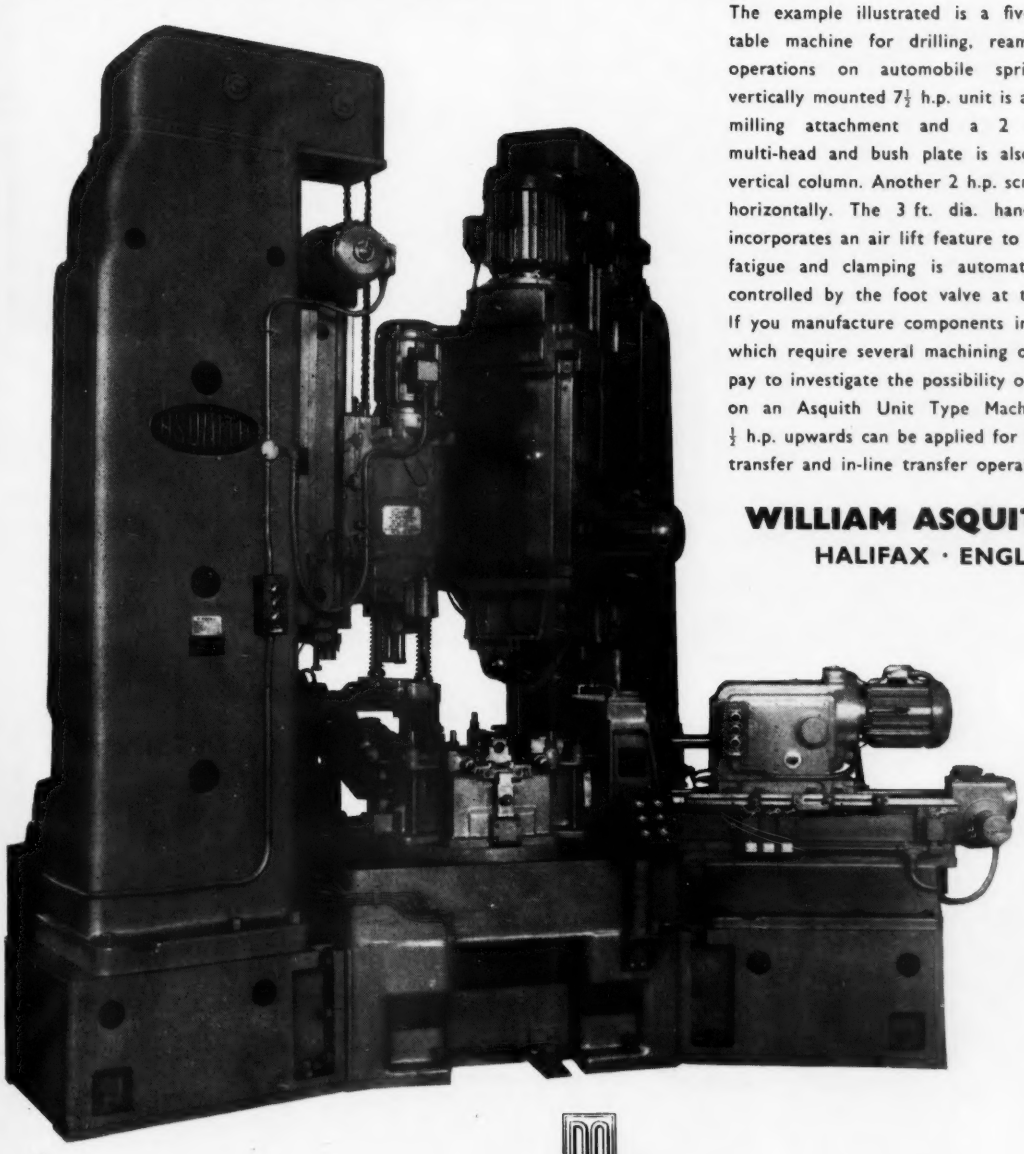


ASQUITH 7½/10 h.p. Screw feed unit. Type MHS.



The example illustrated is a five station, rotary table machine for drilling, reaming and milling operations on automobile spring hangers. A vertically mounted 7½ h.p. unit is arranged with the milling attachment and a 2 h.p. unit with multi-head and bush plate is also mounted on a vertical column. Another 2 h.p. screw unit operates horizontally. The 3 ft. dia. hand indexed table incorporates an air lift feature to reduce operation fatigue and clamping is automatic. The table is controlled by the foot valve at the base.

If you manufacture components in large quantities which require several machining operations, it will pay to investigate the possibility of producing them on an Asquith Unit Type Machine. Units from ½ h.p. upwards can be applied for multi-way, rotary transfer and in-line transfer operation.

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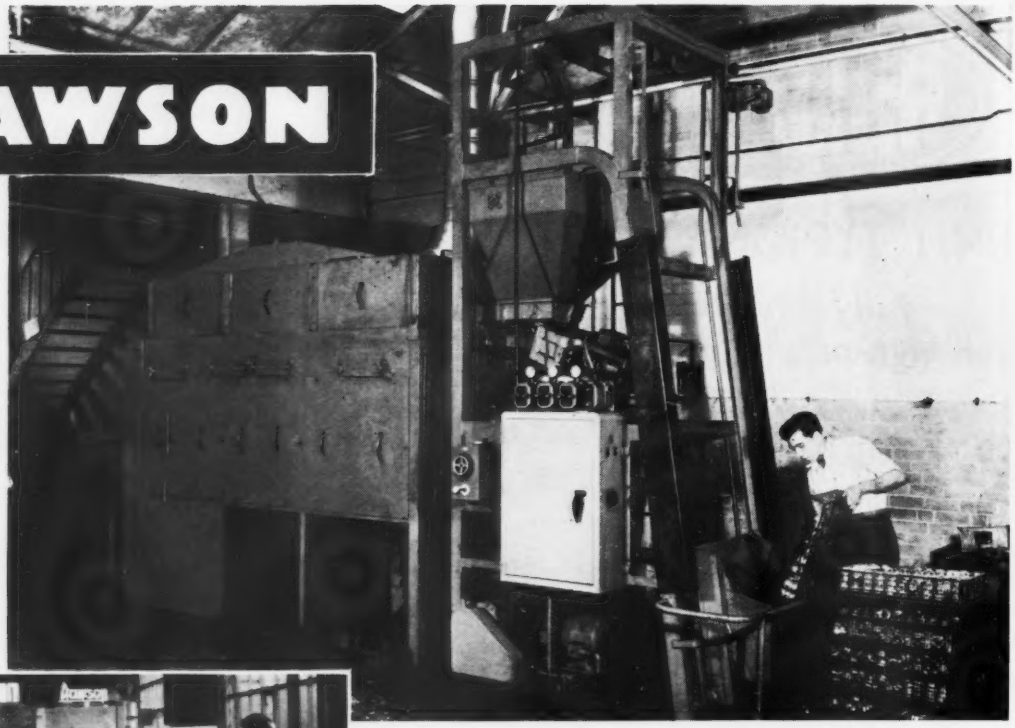
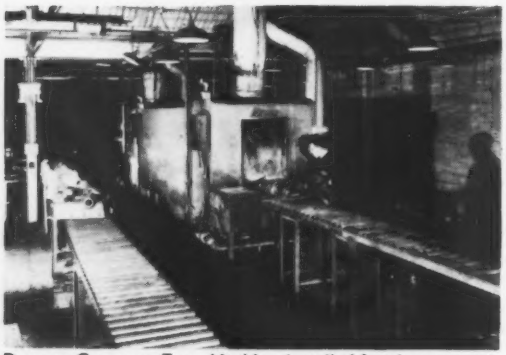


Dawson Rotary Drum Machine with skip hoist for loading. The operator is shown loading the skip with malleable iron pipe fittings.

Dawson Cabinet Type Washing and Drying Machine handling high quality bolts and threaded work.



Dawson Conveyor Type Machine installed for the automatic cleaning of tractor components.

for fast, automatic cleaning and degreasing

Dawson Bros. Ltd. have supplied machines for the automatic cleaning and degreasing of metal parts from small nuts and bolts to castings weighing several tons. Several typical applications are shown here. If you have a cleaning or degreasing problem, a Drummond-Asquith specialist will gladly investigate your requirements.

ULTRASONIC CLEANING & DEGREASING MACHINES

Dawson plant for superfine cleaning is available in two types, one machine for high-frequency operation and the other for low frequency (illustrated). With this type of equipment it is, of course, necessary to determine the correct treatment required for specific components before proceeding with any scheme and our engineers will be pleased to offer expert advice.

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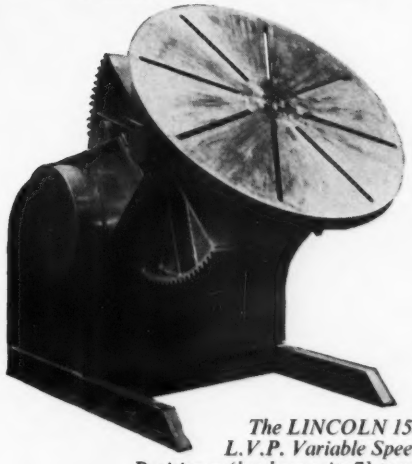

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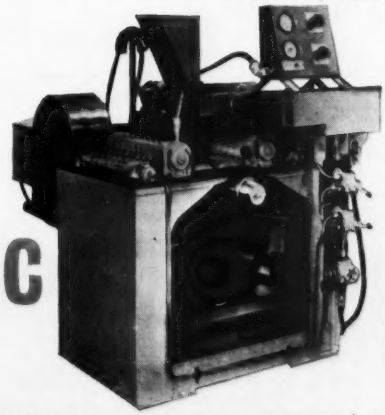

A LINCOLN Seam Welding Machine, incorporating the LINCOLNWELD M.L.3. Remote Control Automatic Submerged Arc Welding Unit.

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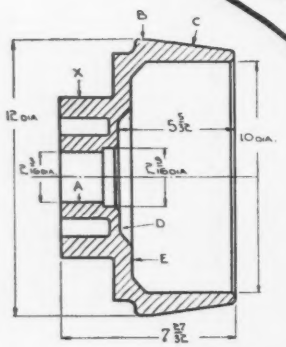

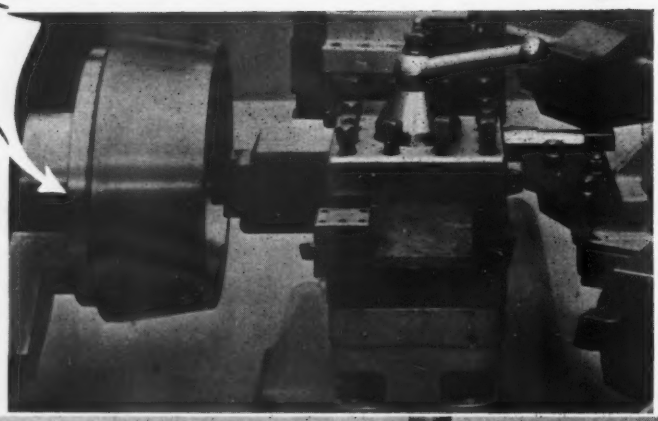

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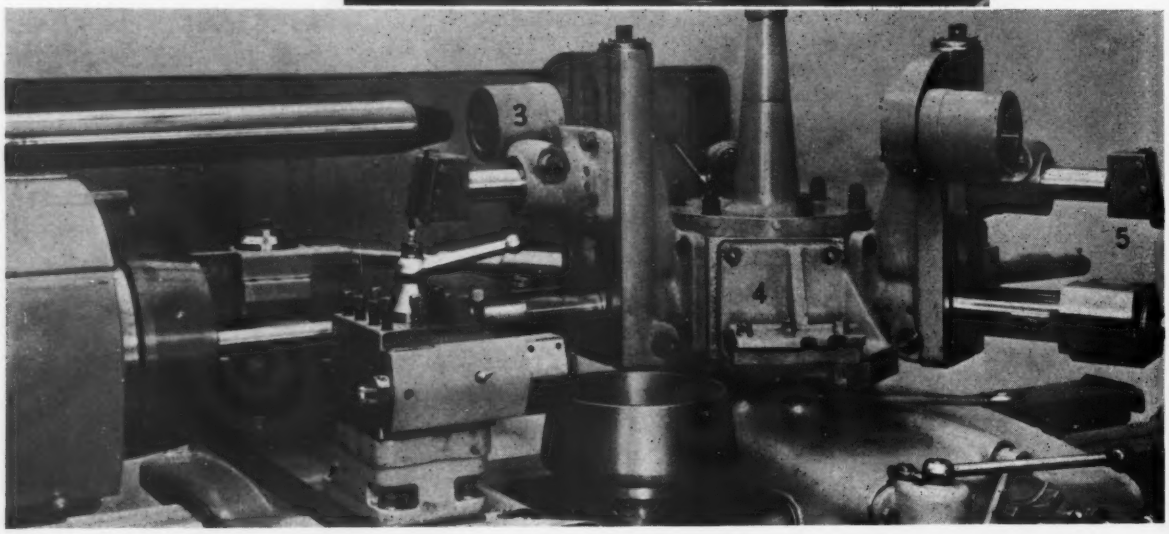
Tungsten Carbide Cutting Tools



DESCRIPTION OF OPERATION	Tool Position		Spindle Speed R.P.M.	Surface Speed Ft. per Min.	Feed Cuts per inch
	Hex. Turret	Cross-slide			
1. Chuck on X (using Loading Attachment)	1	—	—	—	Hand
2. Rough Bore A & 2 3/16" dia. and Chamfer	2	—	375	260	64
3. Face (2 Cuts)	—	Front 1	93	278	64
4. Rough Bore 10" dia. Rough Knee Turn B and Rough Taper Turn C	— 3	— Rear	75	240	44
5. Contour Face D & E (Rough & Finish)	4	Front 3	93/125	242/325	64
6. Finish Bore 10" Finish Knee Turn B and Finish Taper Turn C and Chamfer 10" dia.	— 5	— Rear	125	390	64
7. Chamfer Outside Dias.	—	Front 2	125	390	Hand
8. Finish Microbore 2 3/16" dia.	6	—	580	333	88
9. Remove (using Attachment)	1	—	—	—	Hand

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No. 10 TURRET LATHE

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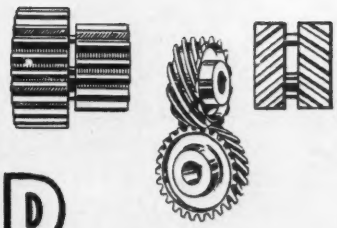
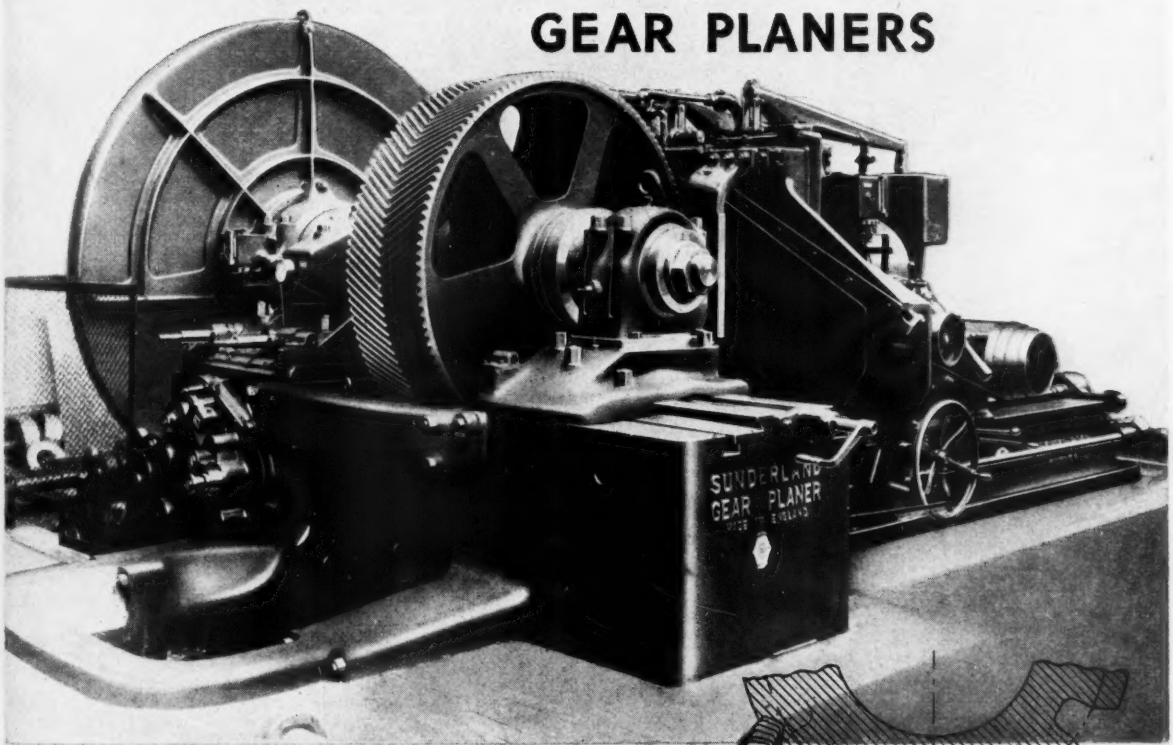


SUNDERLAND

GEAR PLANERS



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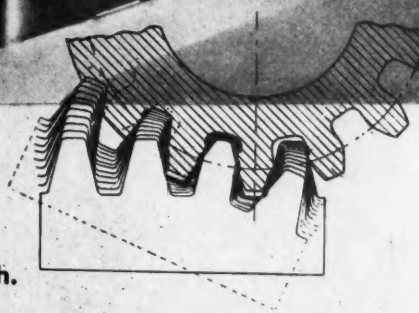

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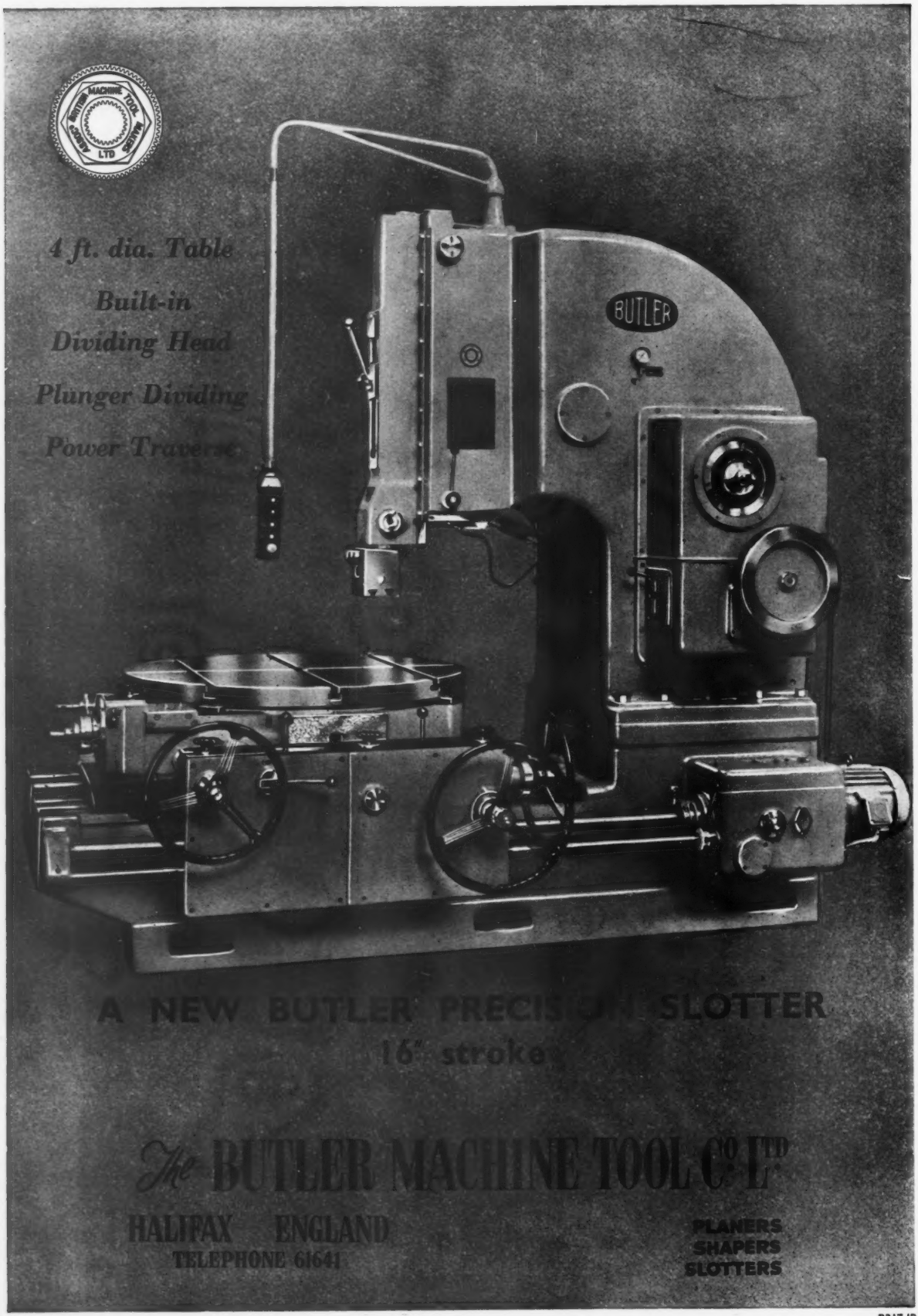
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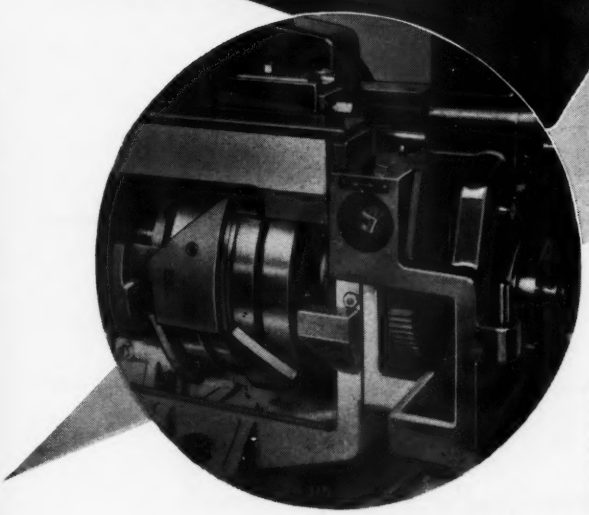

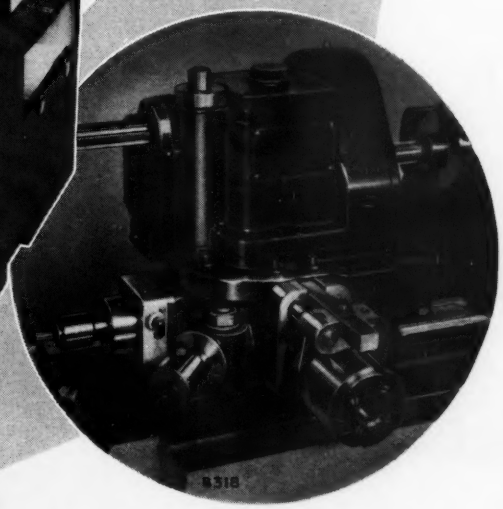

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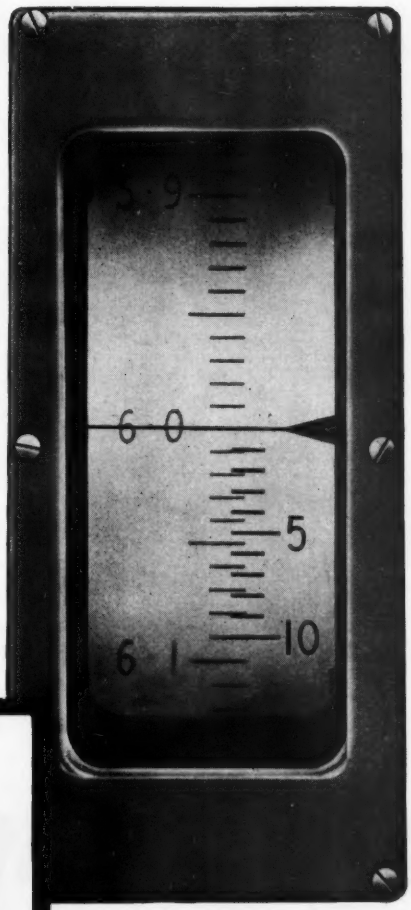

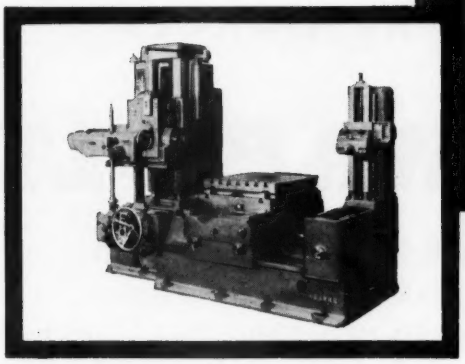

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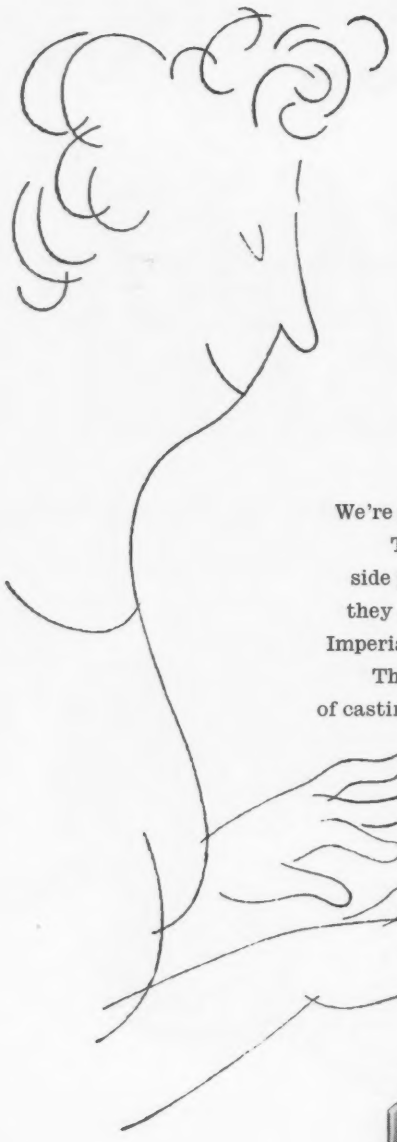

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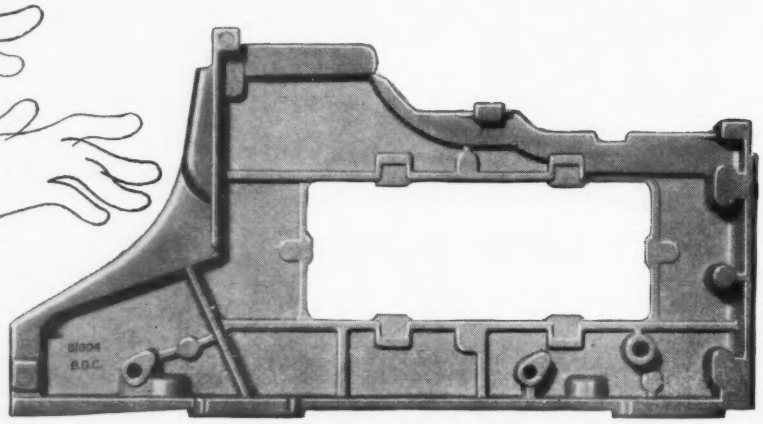

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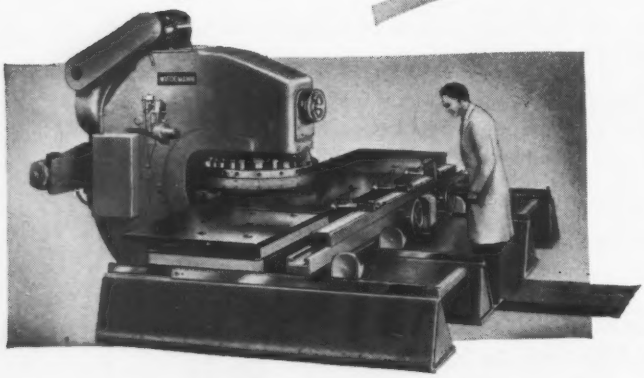

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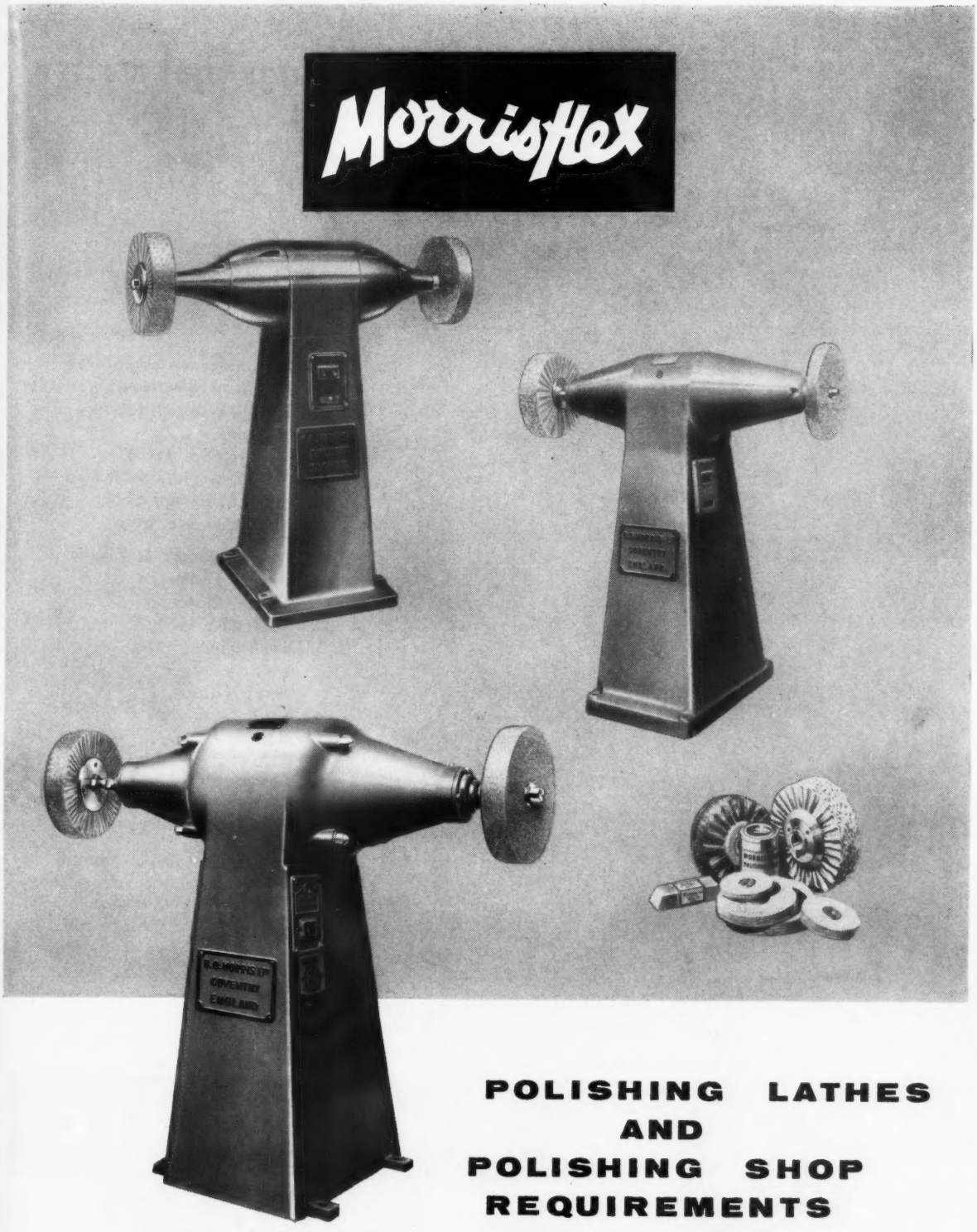

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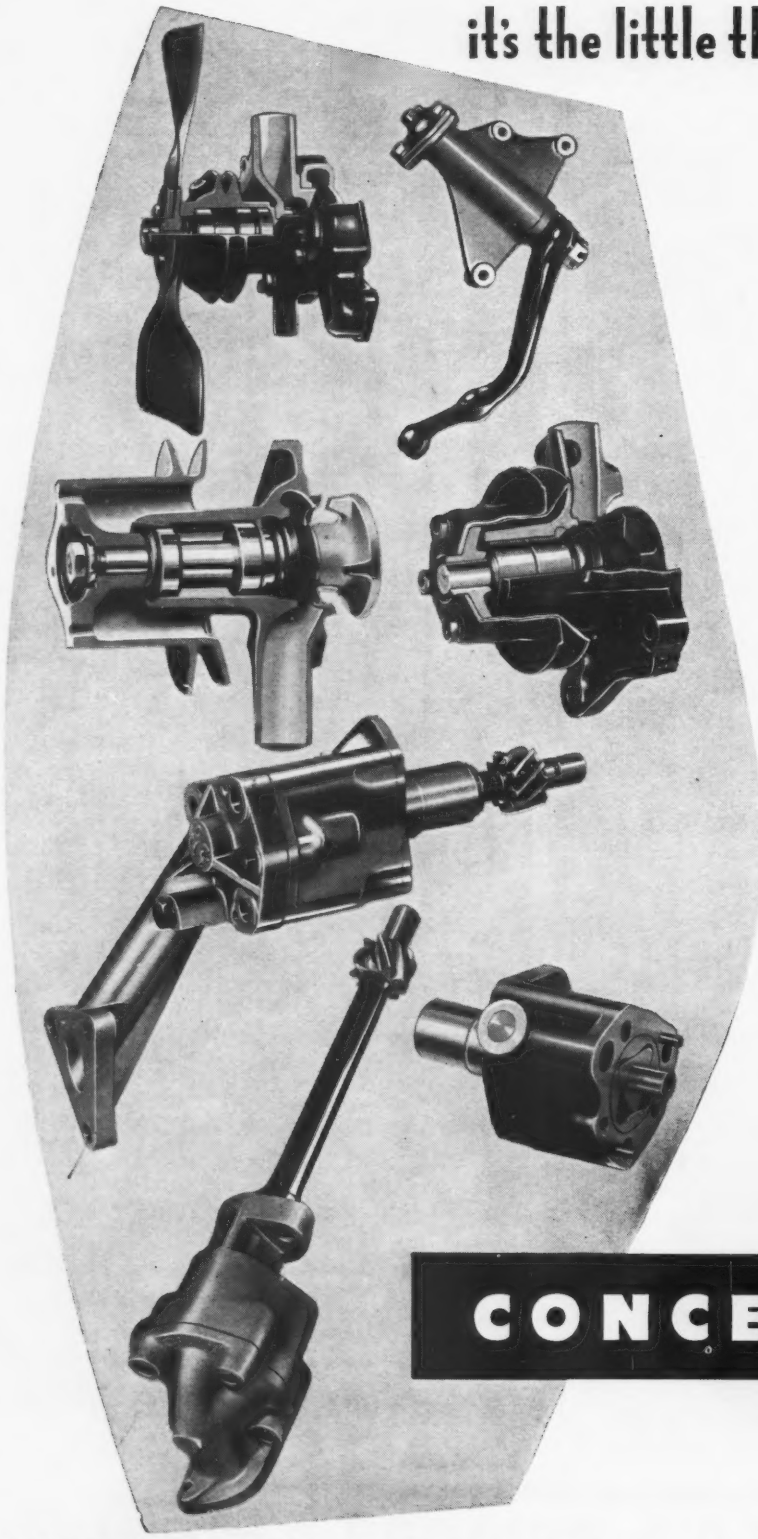

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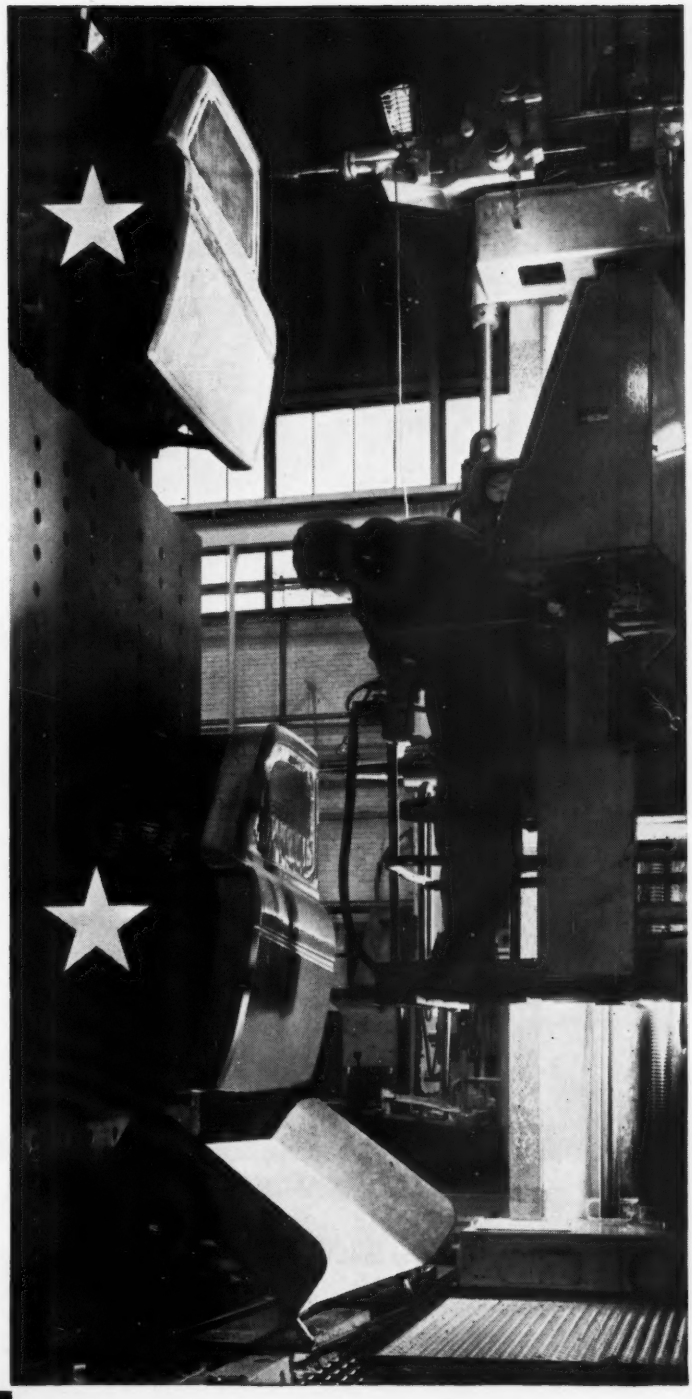

This die-sinking machine is producing a metal punch for a car door outer panel, from a model made of Araldite epoxy resin. A stylus engages with the Araldite model, and its movements are repeated exactly in producing the metal punch. 4/5 weeks are required for the production of this punch, and the Araldite model retains its dimensional stability, in contrast with the distortion and fragility associated with the use of wood and plaster models. The Araldite unit is tough, durable and does not deteriorate in storage. Further information on numerous applications of Araldite in tool making is contained in a recent publication "Araldite for Tooling" manual E.T., which will be sent gladly on request.

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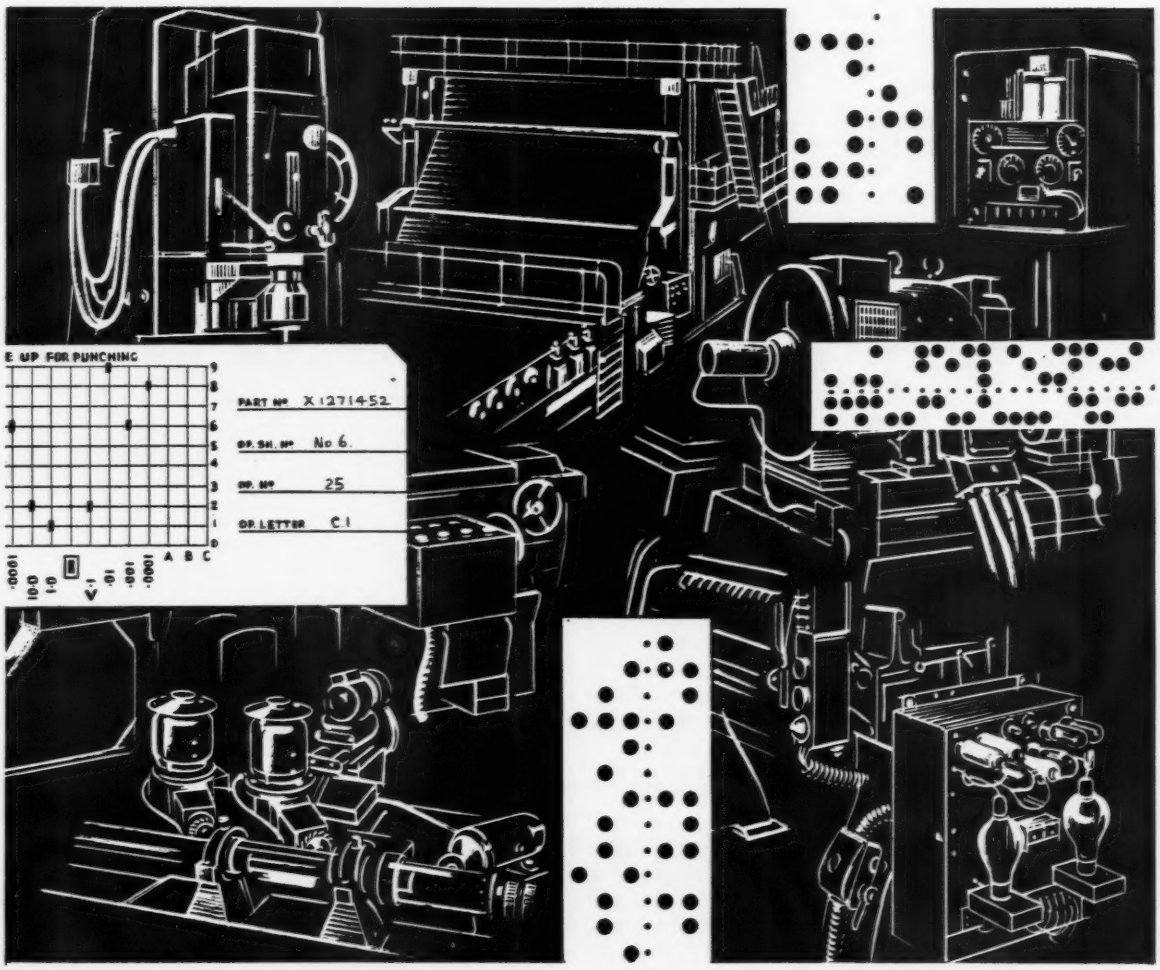

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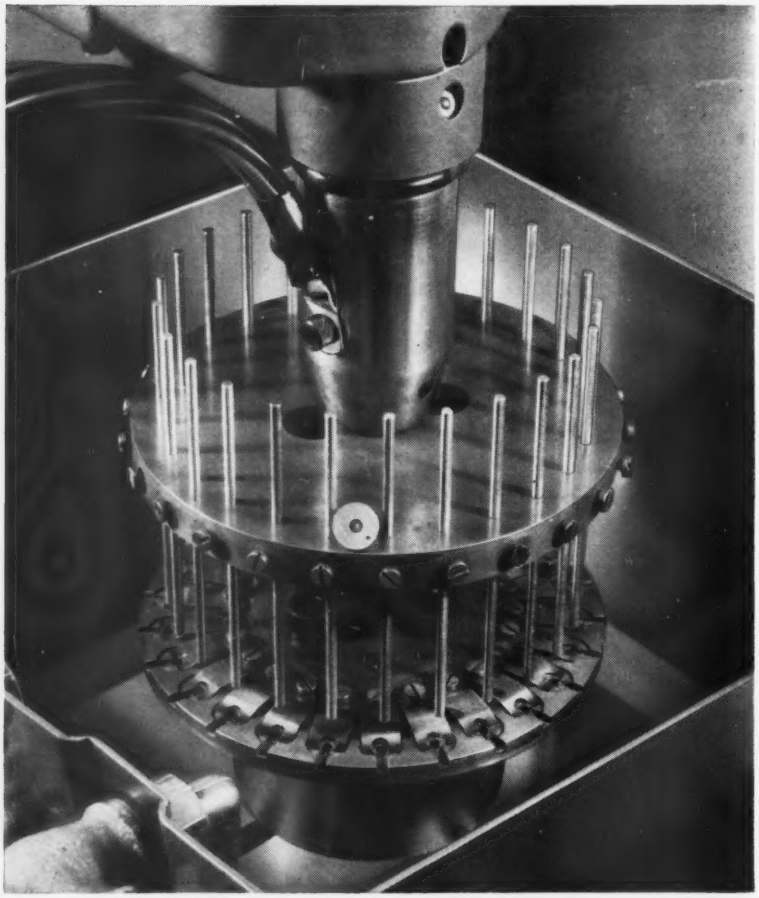
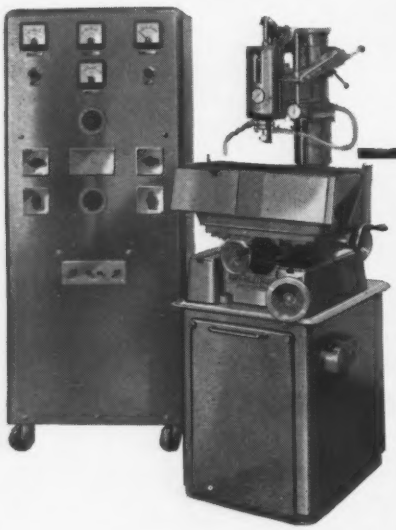
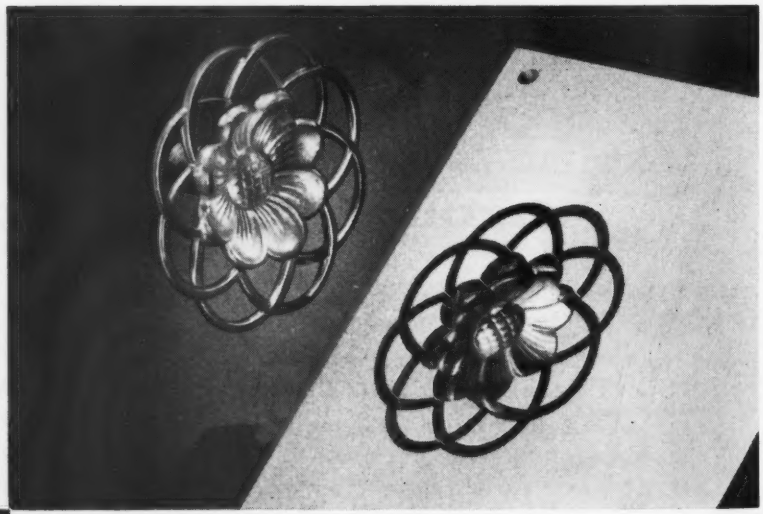


(*Right*)
Holder used in conjunction with a jig for the precise boring of small carbide components.





(*Right*)
An intricate electrode (Mazak) and finished workpiece (high carbon steel).

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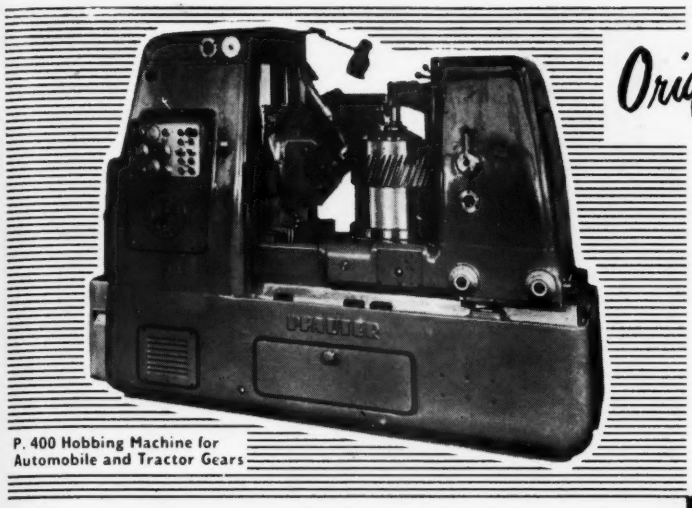

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Original PFAUTER Hobbers

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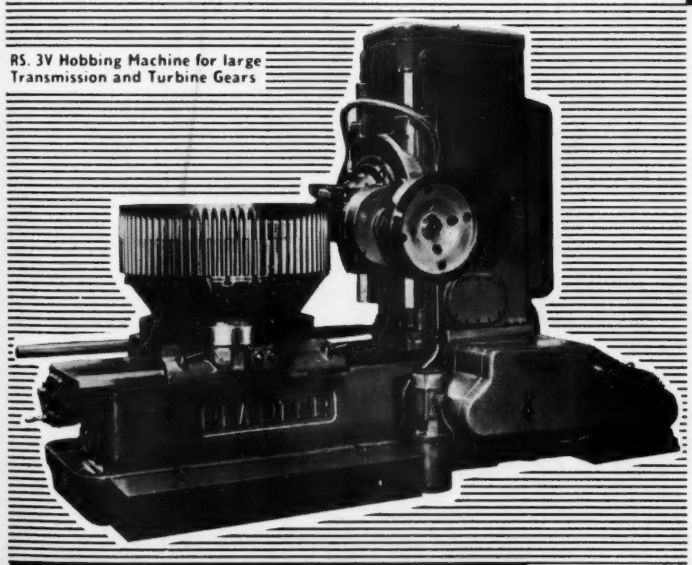

RS. 3V Hobbing Machine for large Transmission and Turbine Gears

MANUFACTURING PROGRAMME

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Model	Max. Gear dia. ins.	Max. Gear width ins.	Max. D.P.
R 16	3	2¼	26
RS 00	10/6	7	17/10
P 250	10/8	6½	10/6
DRA DUPLEX	10	8	3
P 400	16	12	4
P 500	20	15	3
RS 1V	30	12½	3
P 900	35	18	3
P 1250	49	23	2
RS 3V	72/47	25	2½/1¾
P 1800	72	29½	1½
P 2500	100	29½	1½
Horizontal Work Mounting			
P 160	6½	15½	6
RS 9K	11½	28¾	2½
Worm and Thread Milling Machines			
SF 1	11½	28¾	1½

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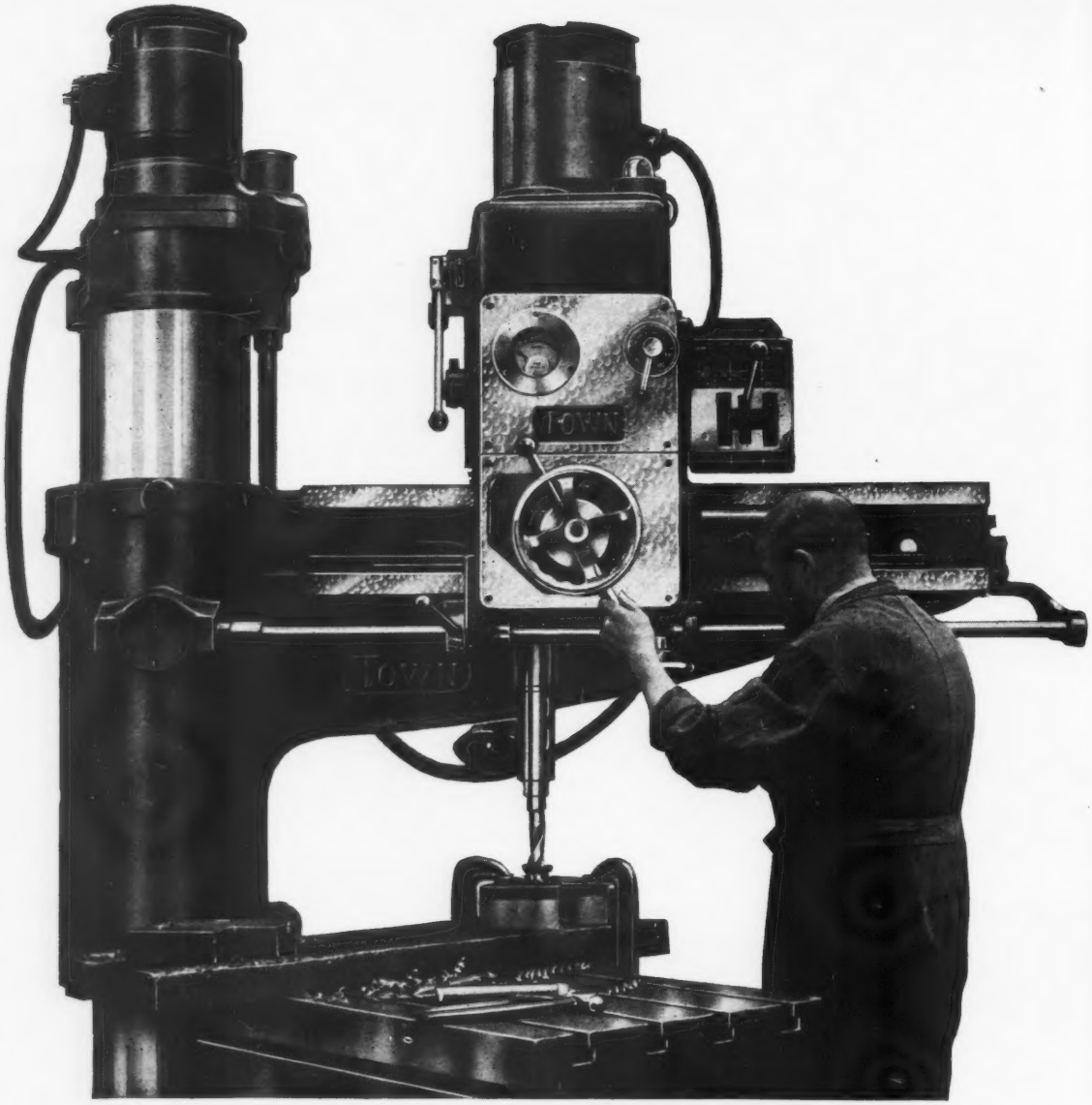

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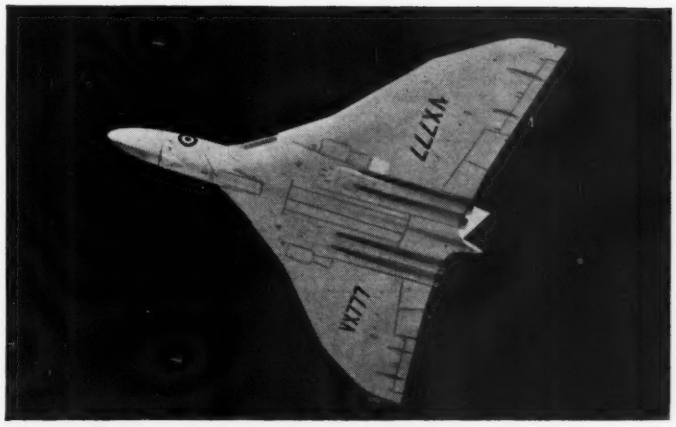

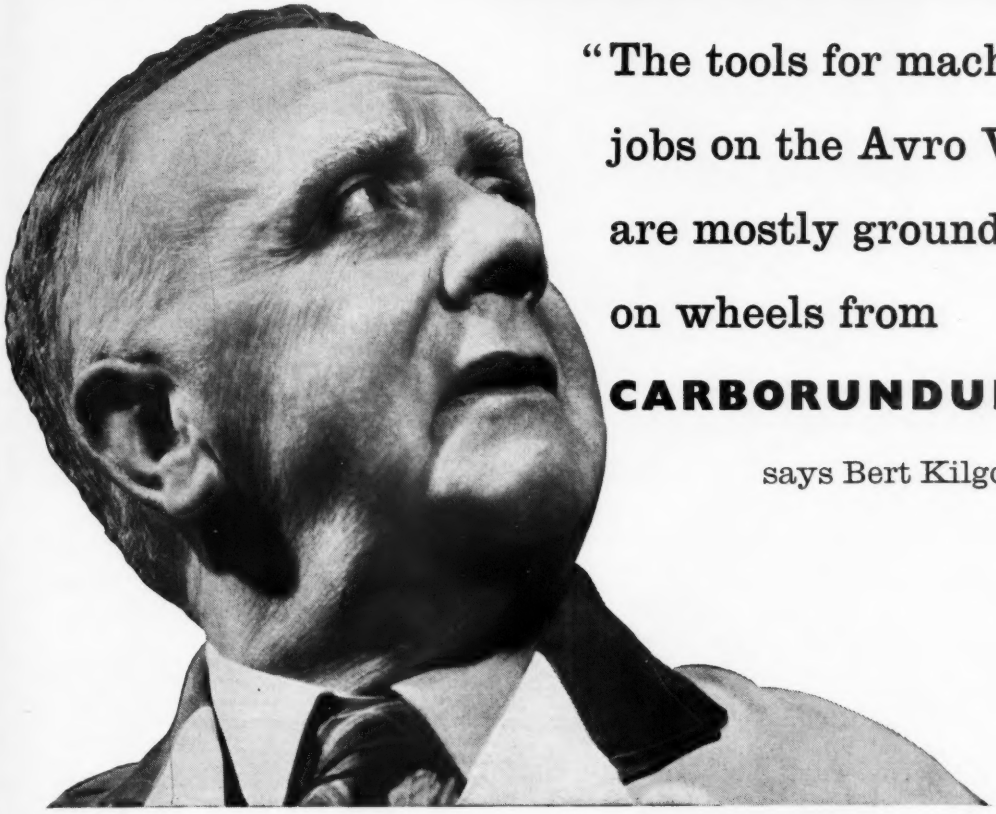

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says Bert Kilgour

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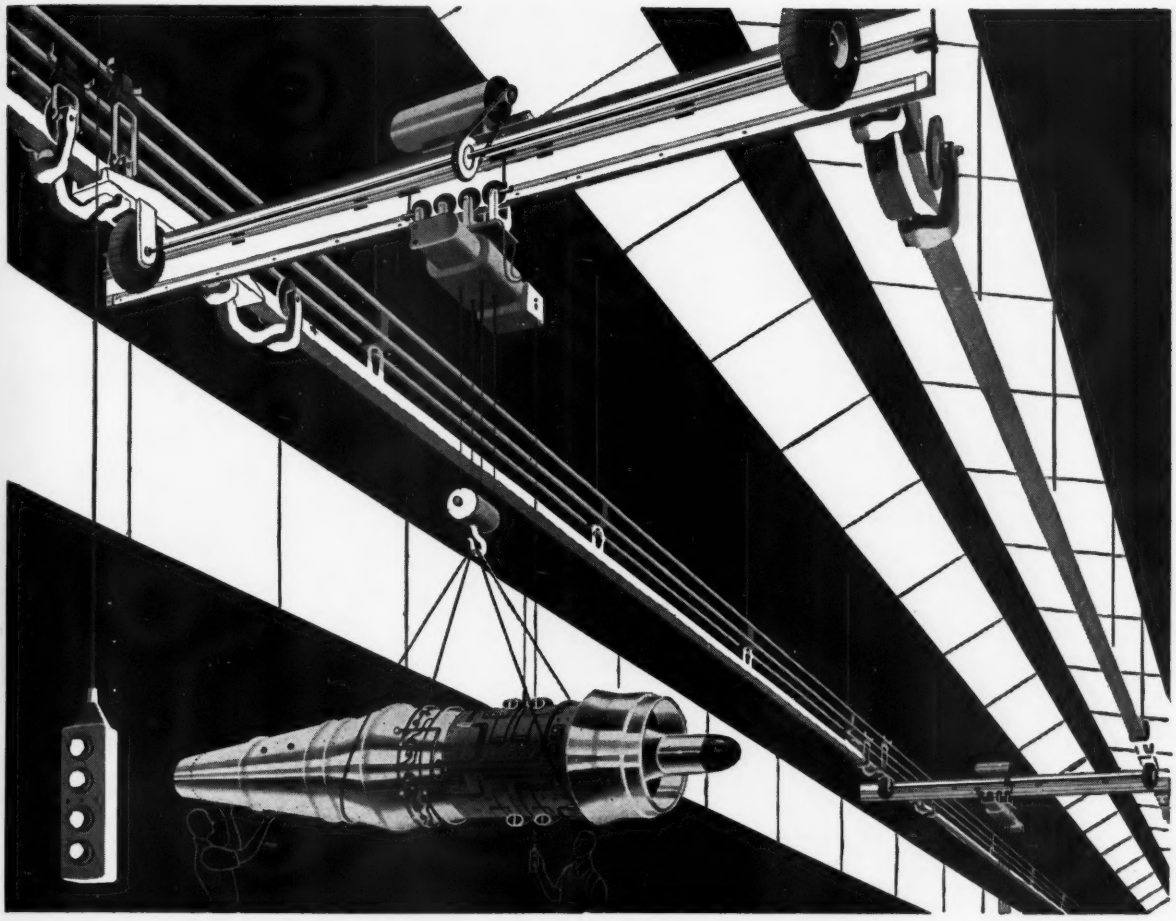
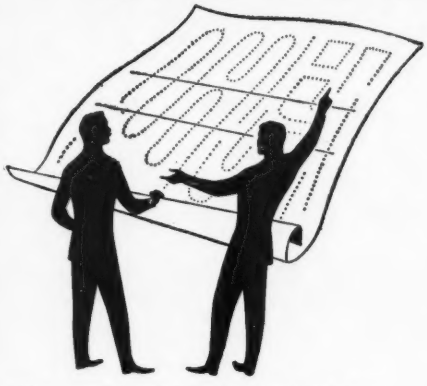


Industry's new motorways speed heavy loads OVERHEAD



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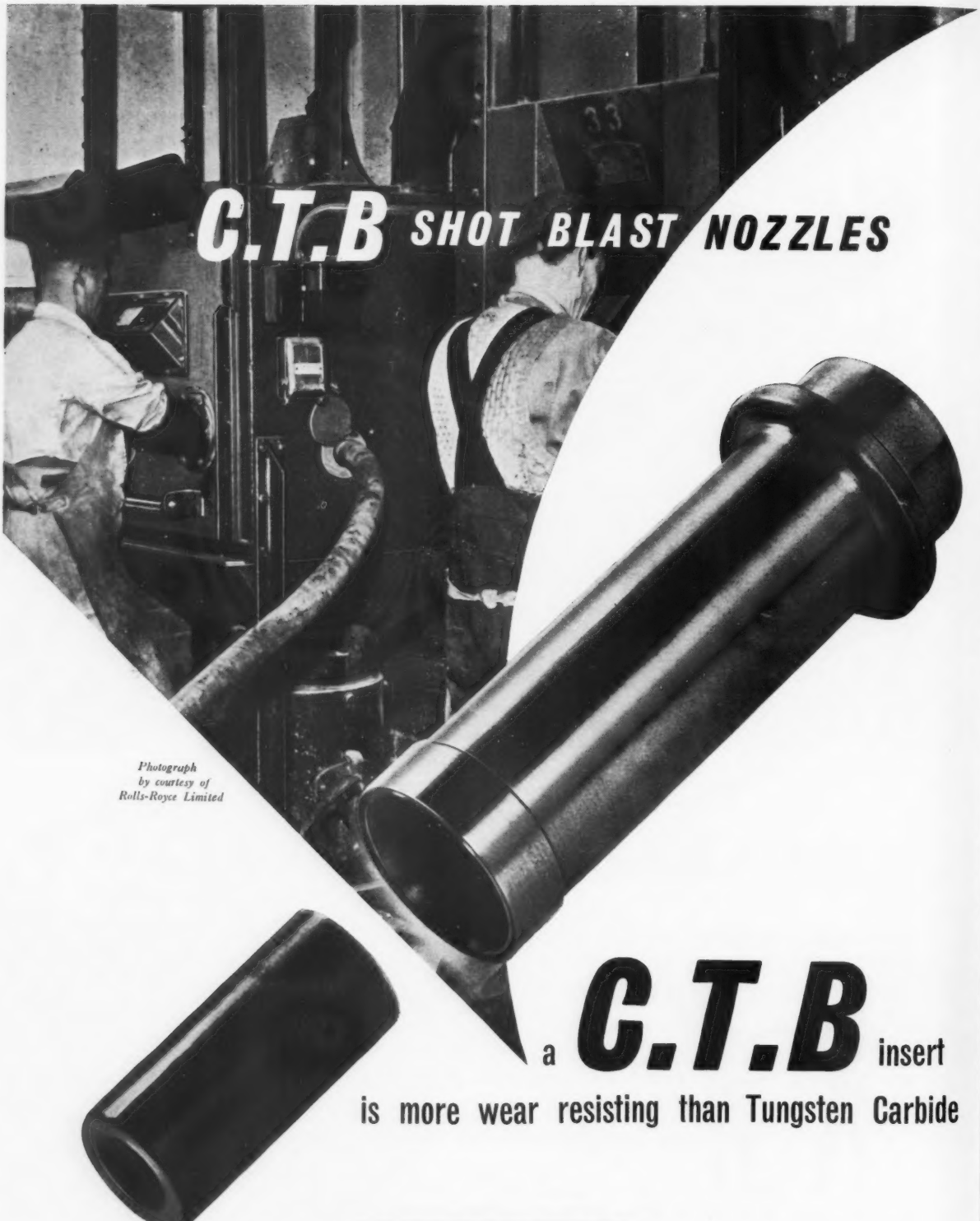

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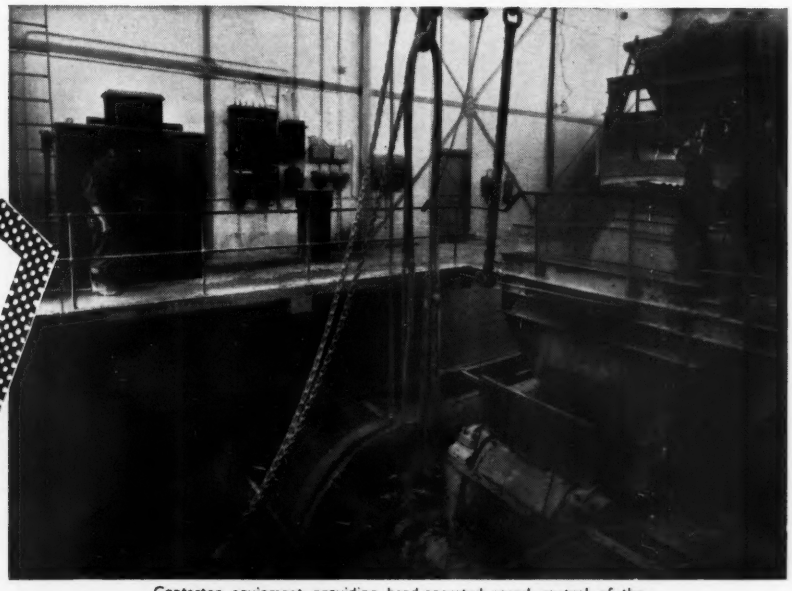
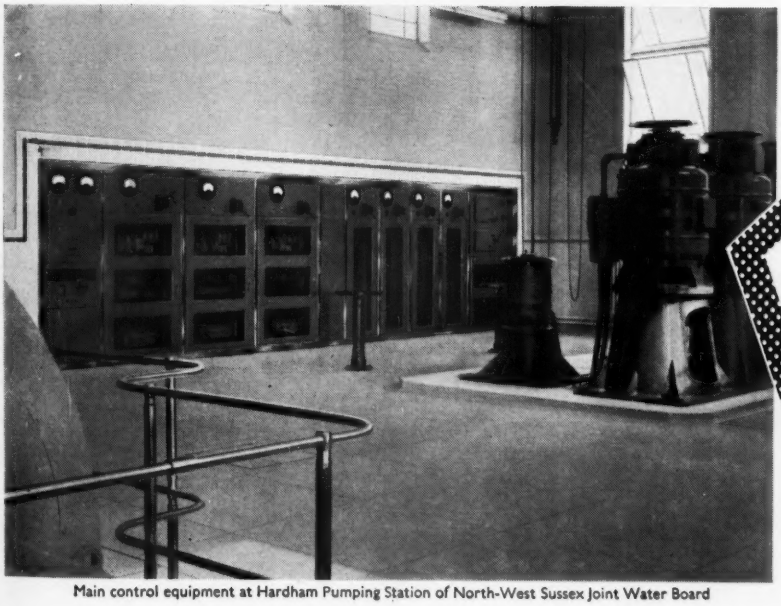


Contactor equipment providing hand-operated speed control of the Primary Crusher of Cornelly Quarry of The Steel Company of Wales Ltd



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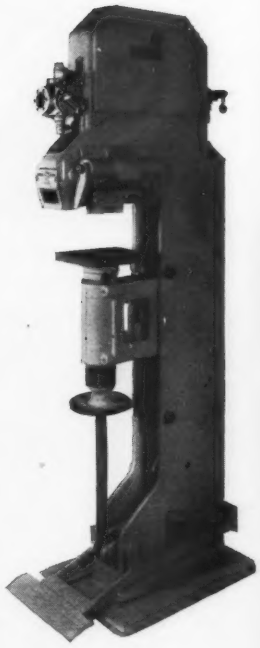

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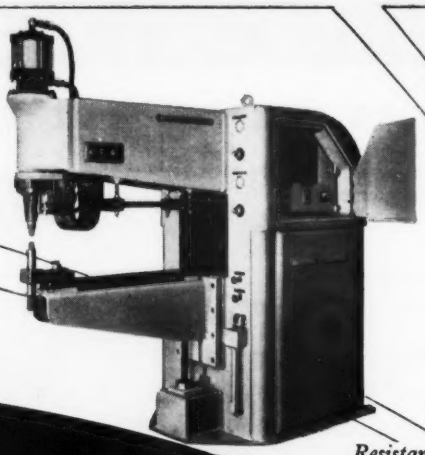
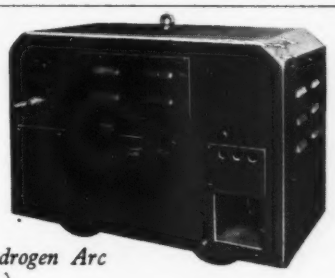
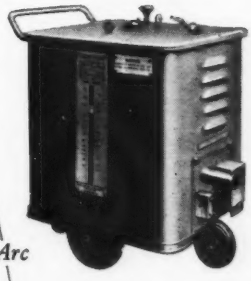


Resistance



Atomic Hydrogen Arc



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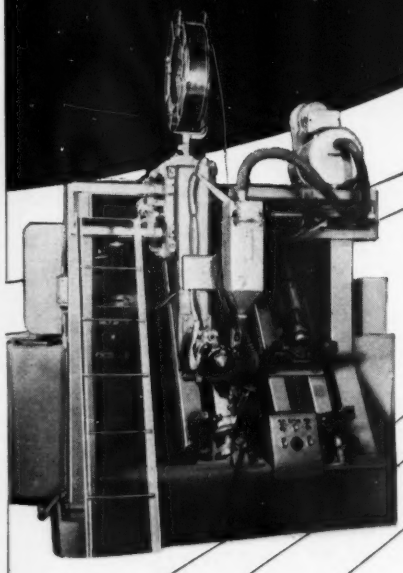

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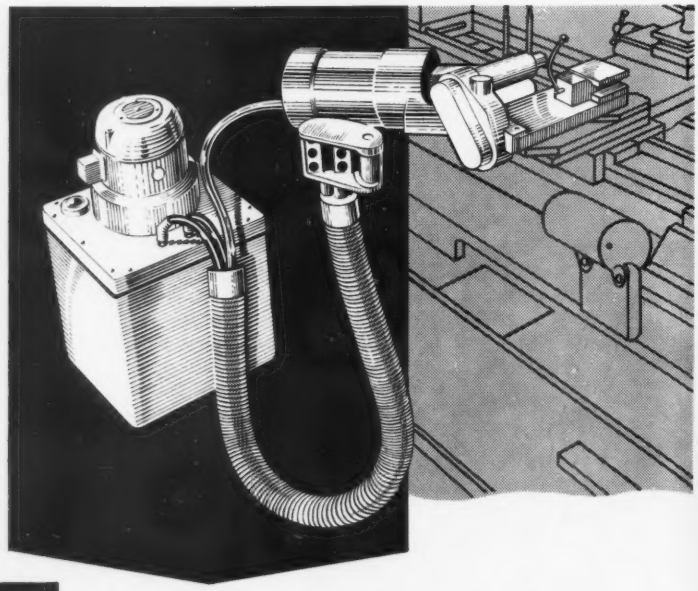

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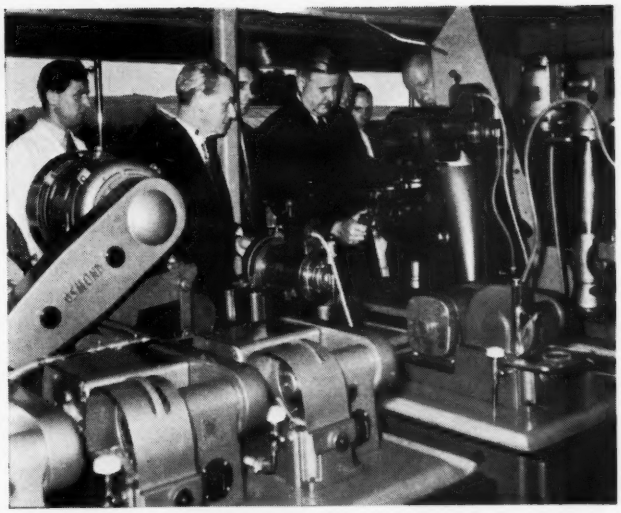

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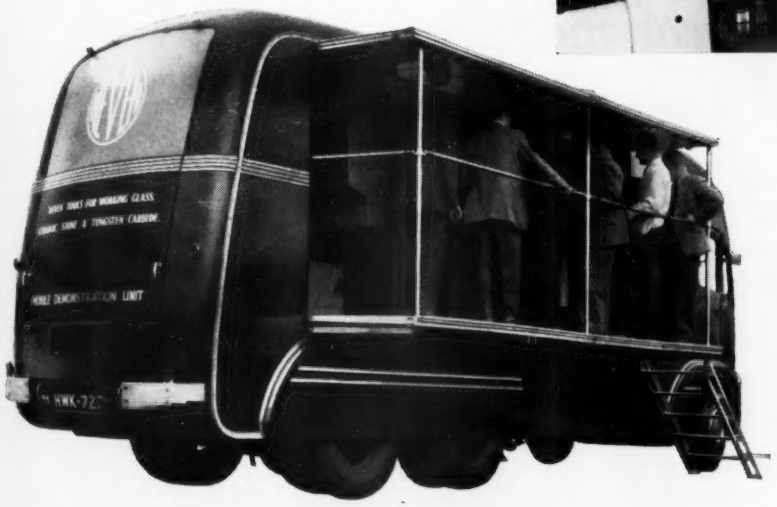

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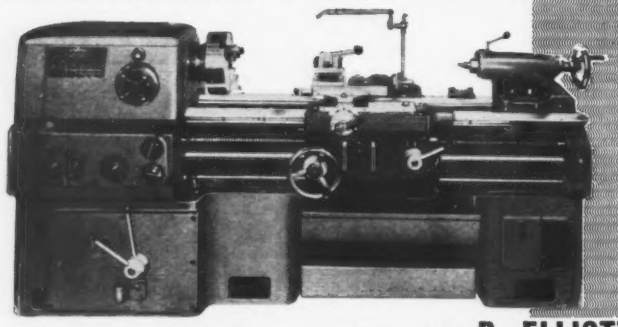

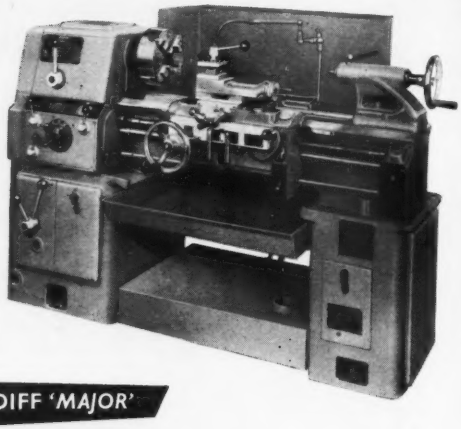

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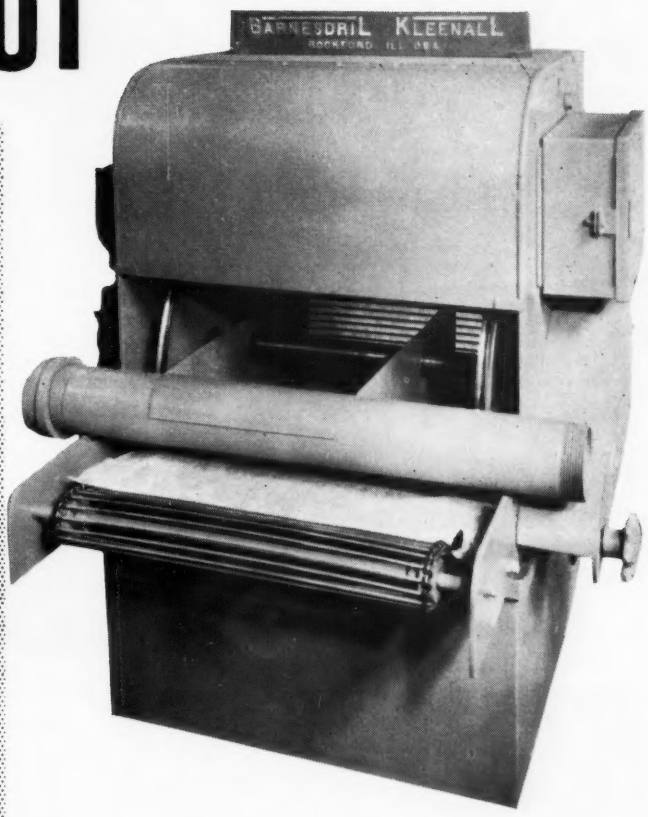

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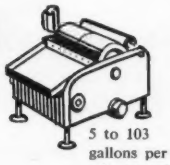

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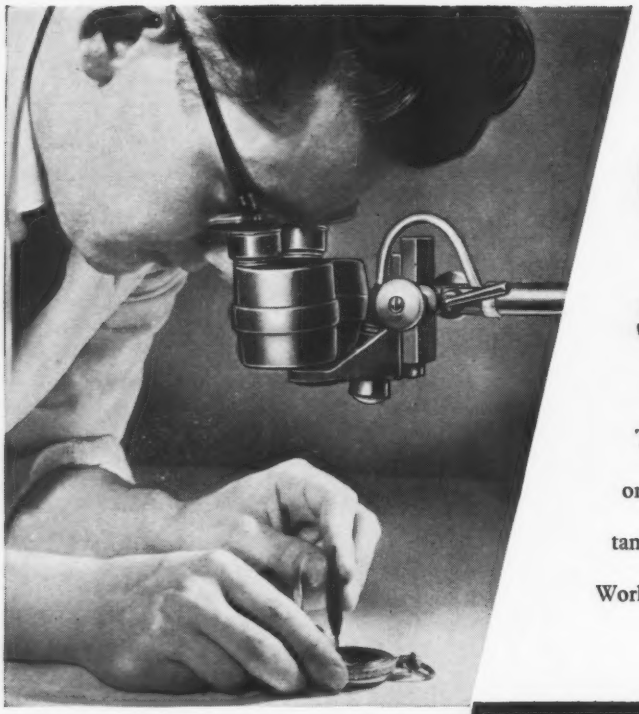

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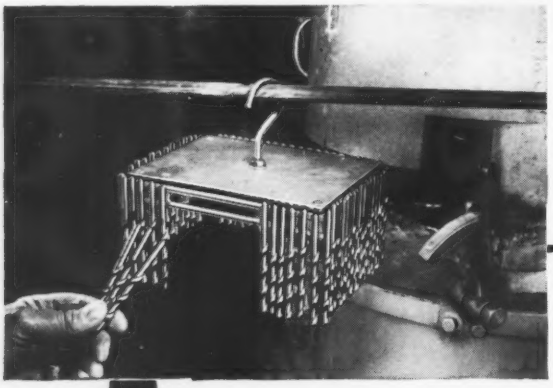

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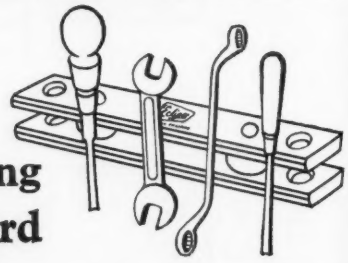

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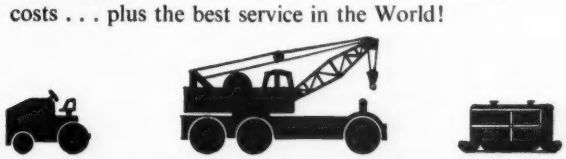

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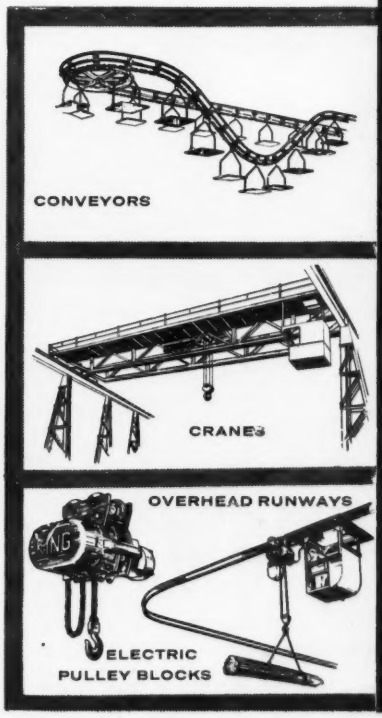

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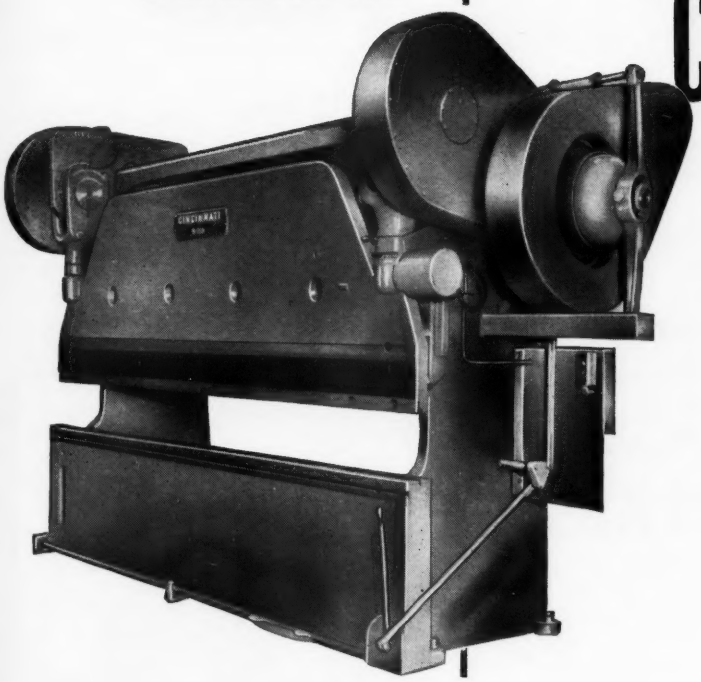

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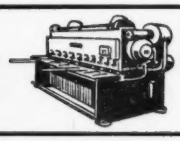

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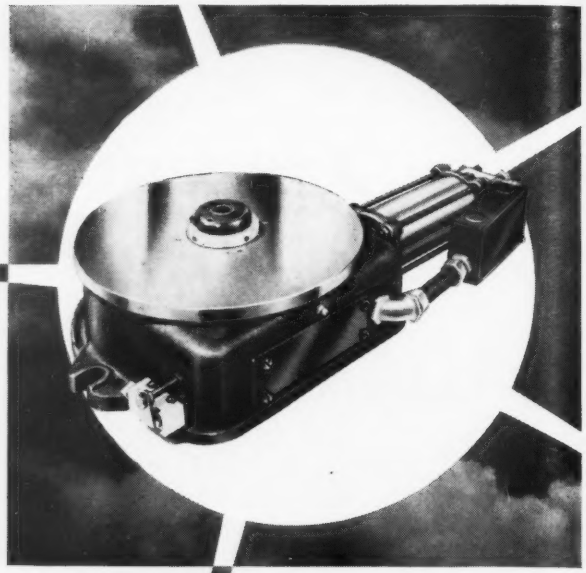

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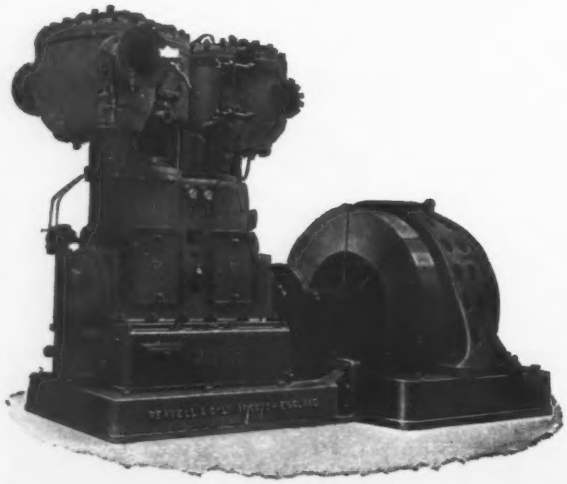

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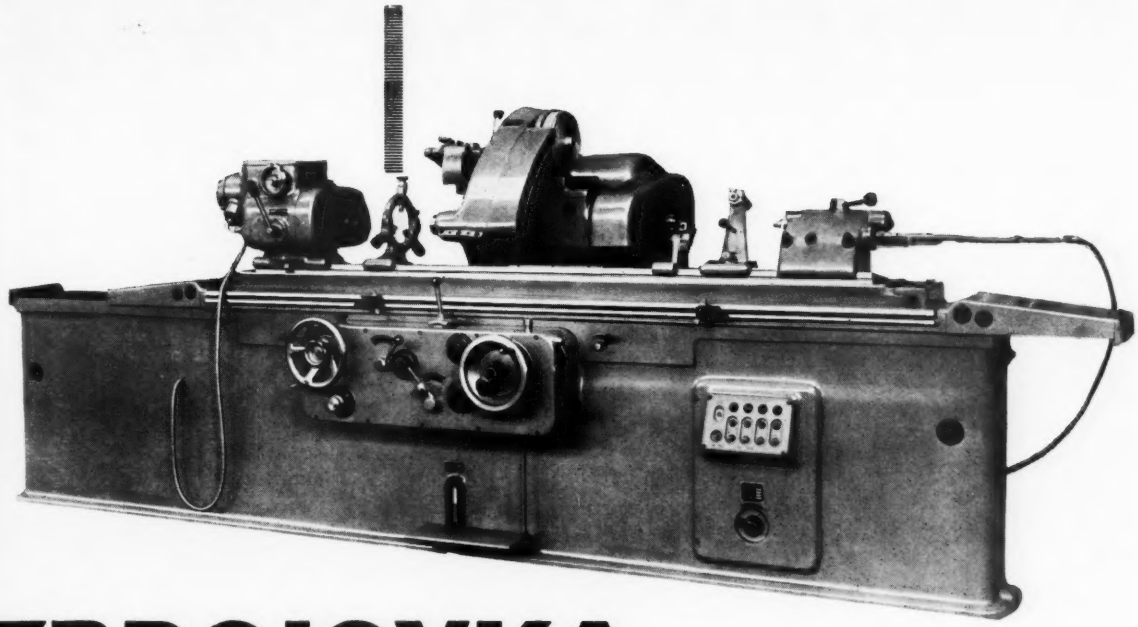

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Max. distance between centres	20"	30"	30"	40"	60"
Grinding wheel (dia x hole x width)	13½"x2½"x5"	13½"x2½"x5"	19½"x3"x8"	19½"x3"x8"	19½"x3"x8"
R.p.m. of work	50—750	50—750	25—750	25—750	25—750
Table traverse per min.	4"—19' 8"	4"—19' 8"	4"—19' 8"	4"—19' 8"	4"—19' 8"
Table swivels by	6°	6°	6°	5°	5°
Work headstock swivels by	90°	90°	90°	90°	90°
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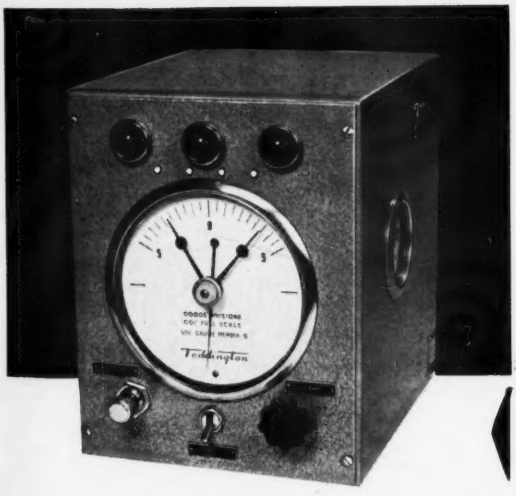

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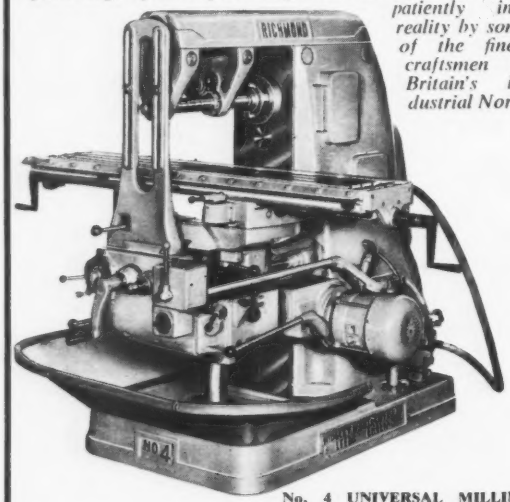

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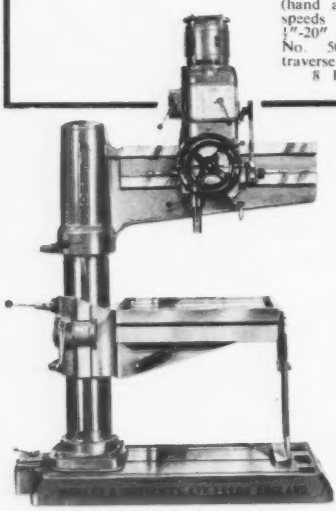

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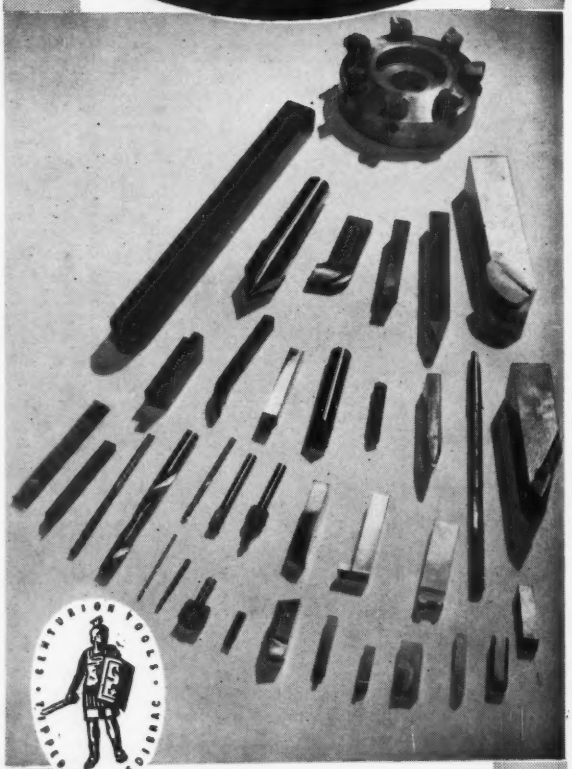

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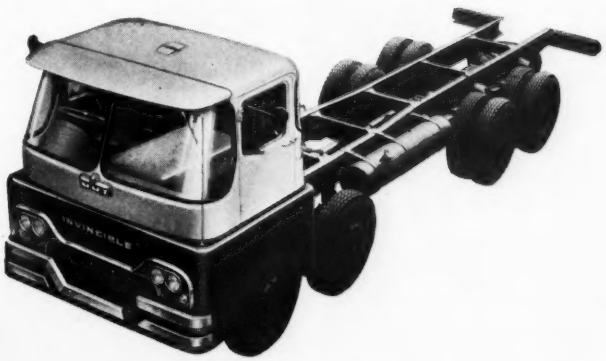

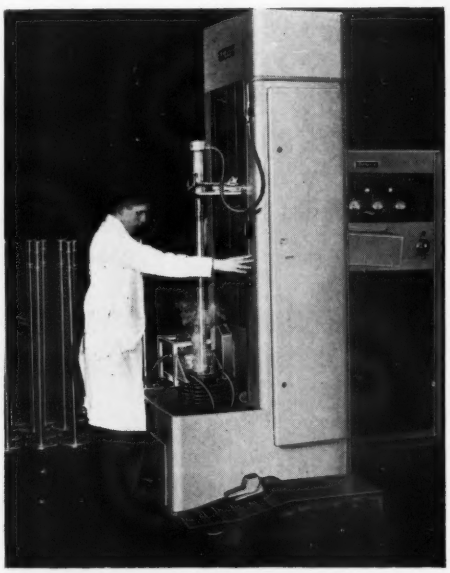

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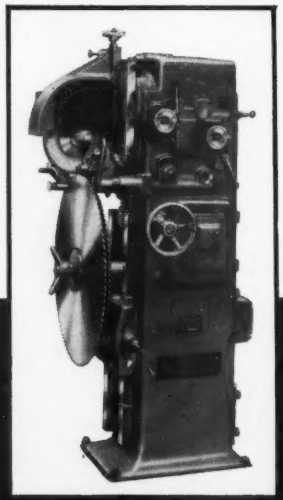

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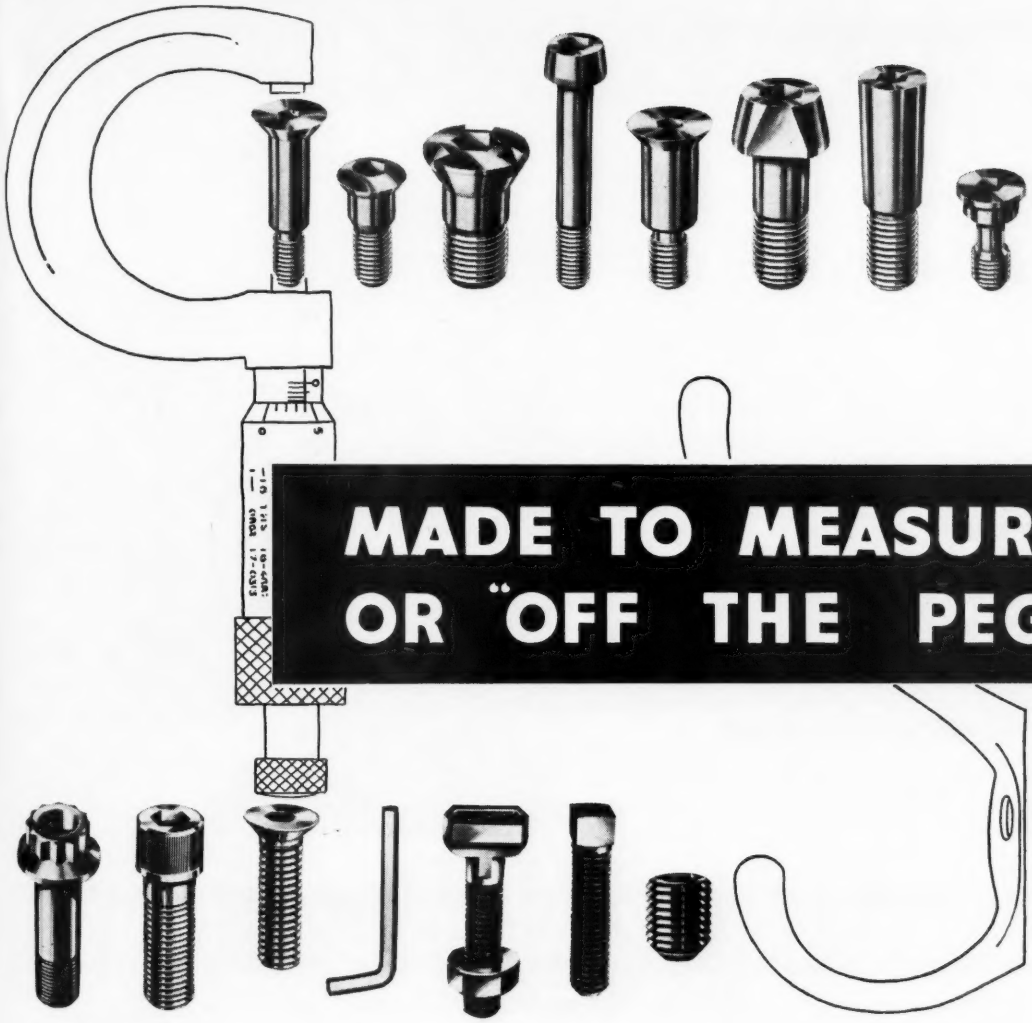

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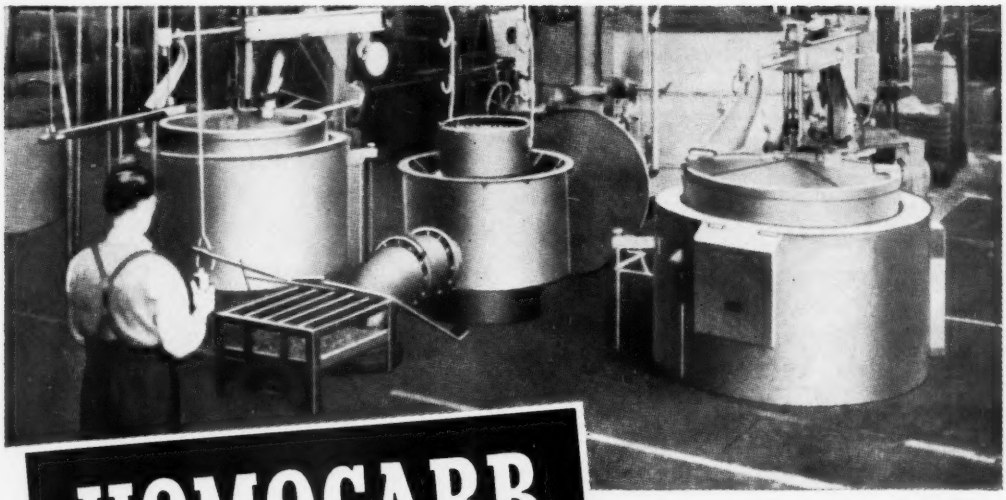

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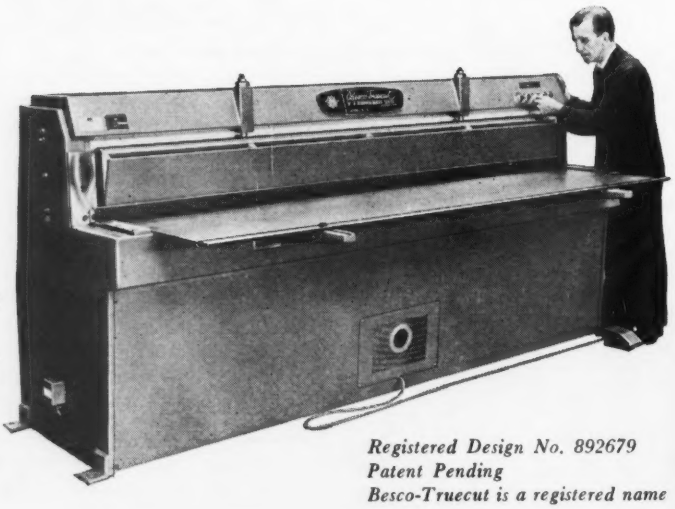

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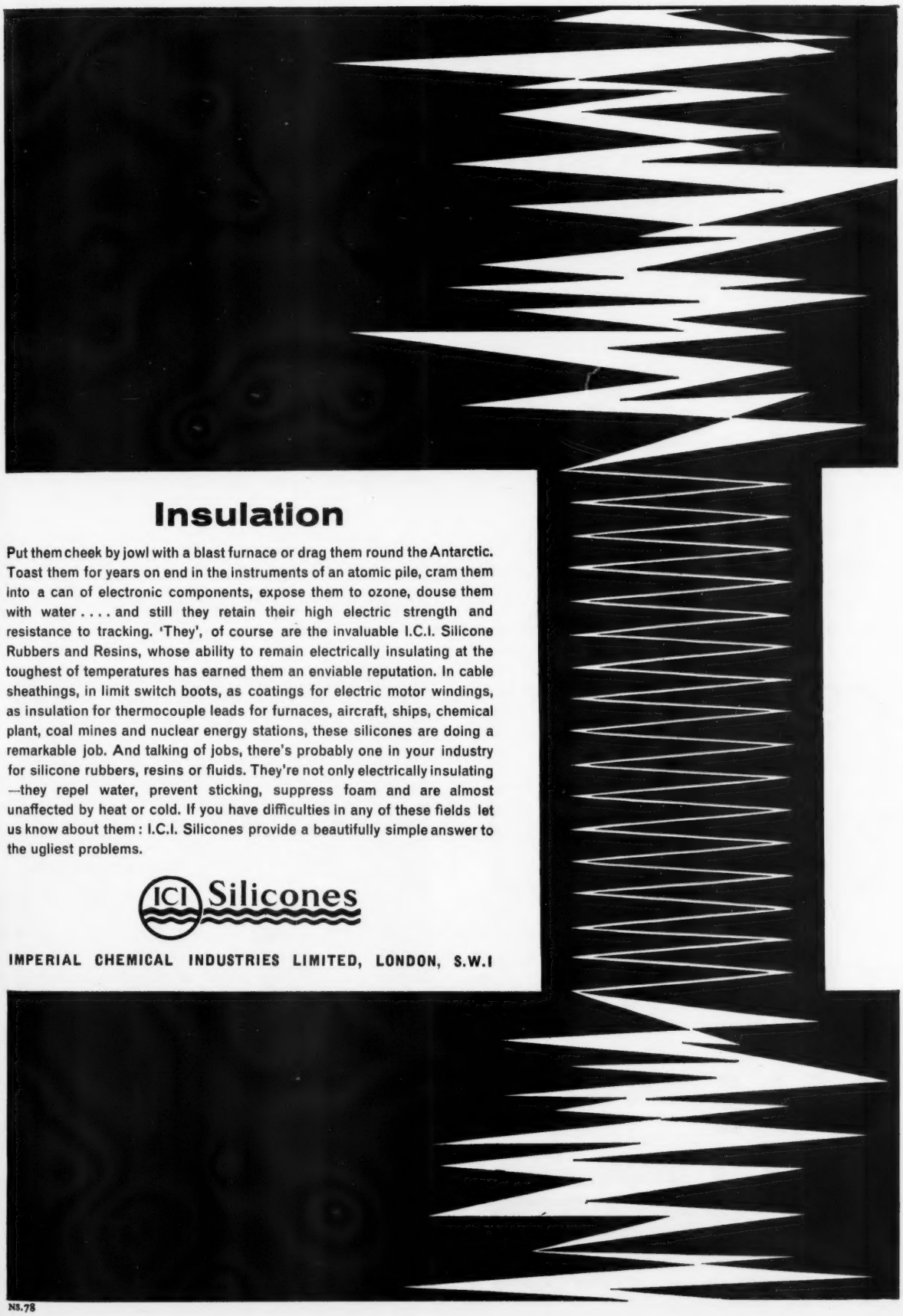

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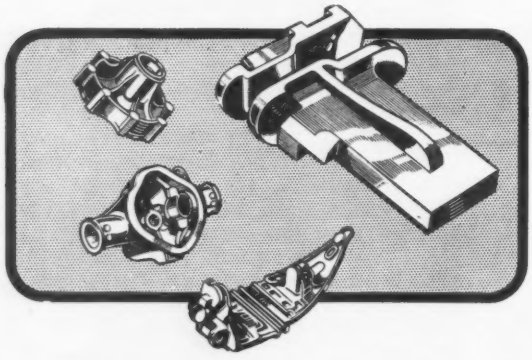

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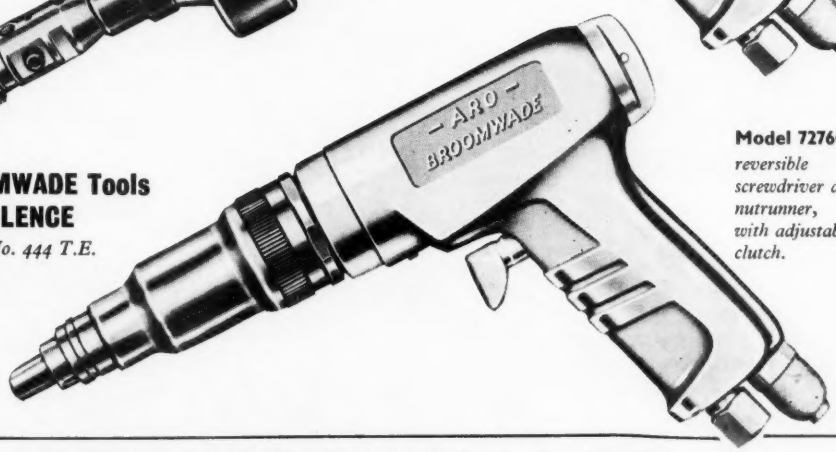

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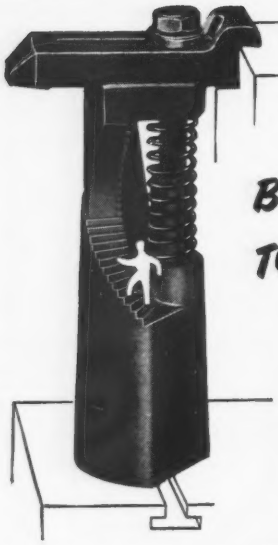

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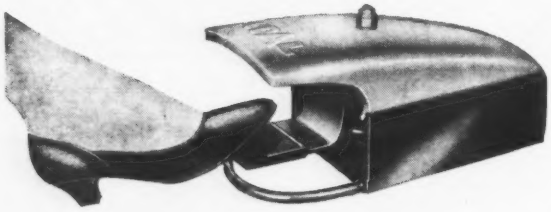

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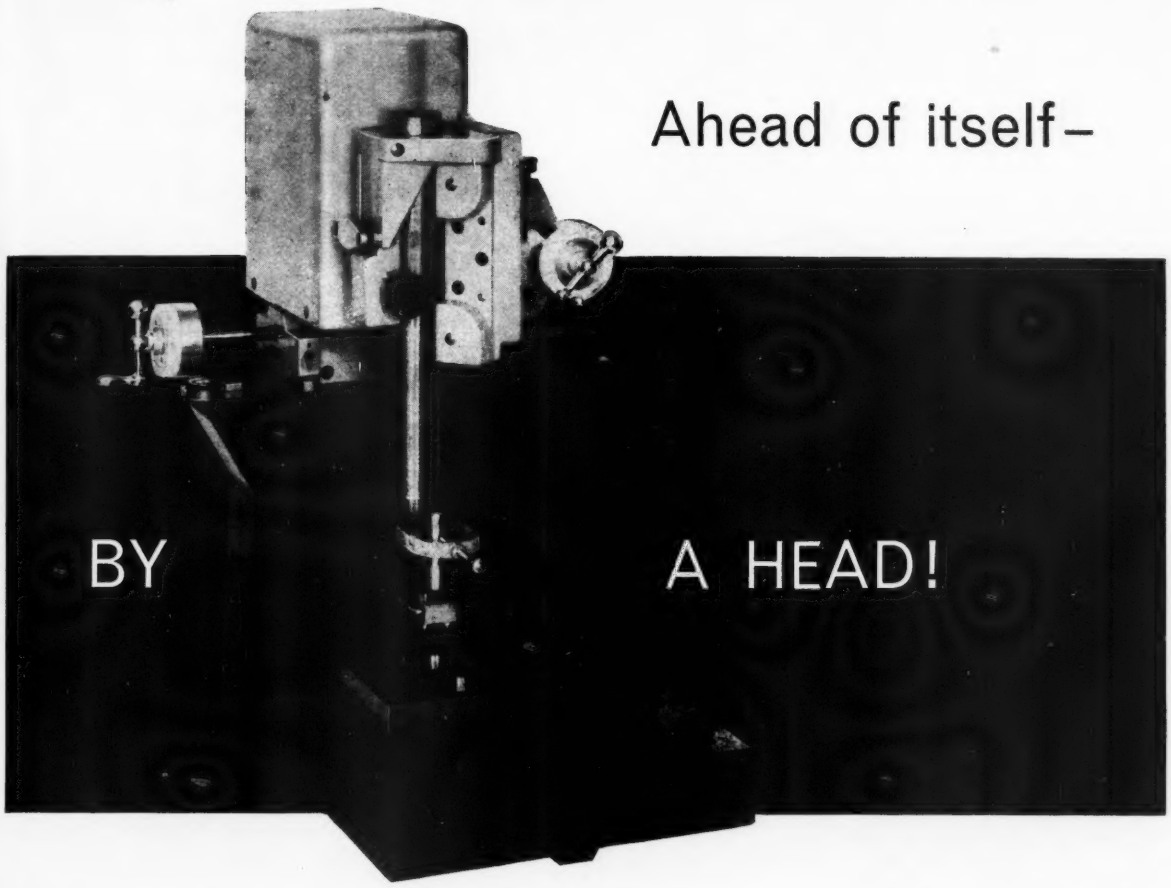

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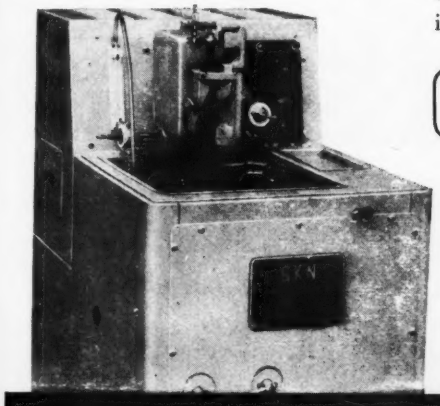

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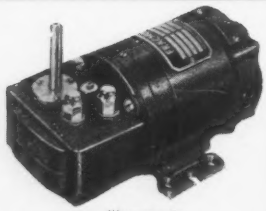

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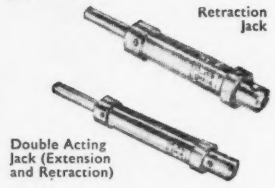

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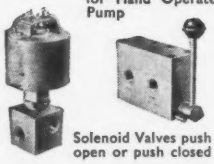

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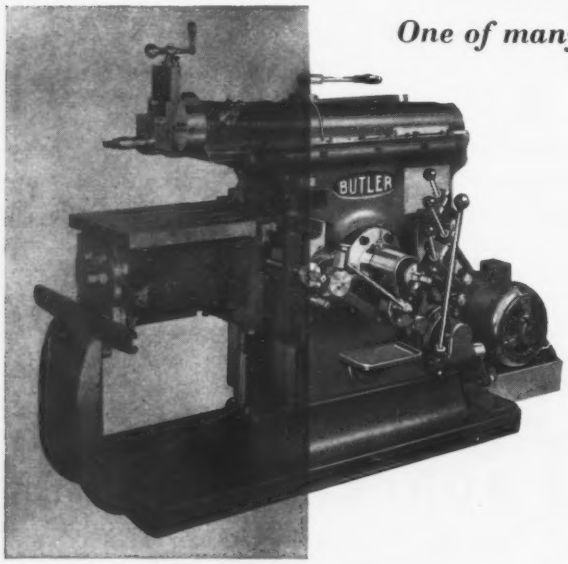

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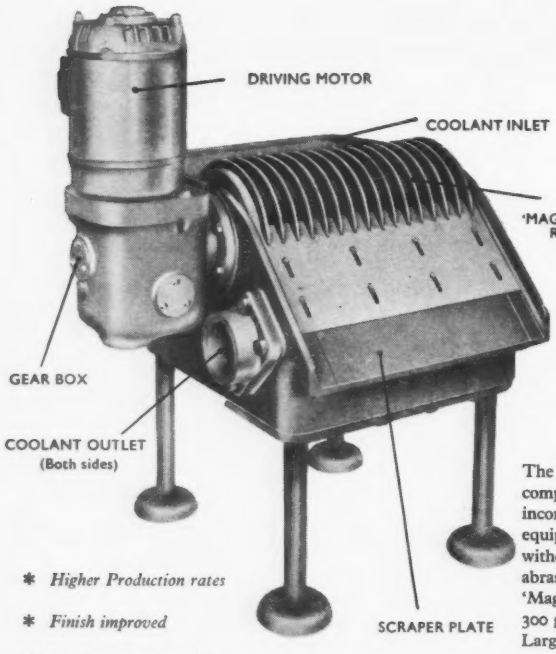

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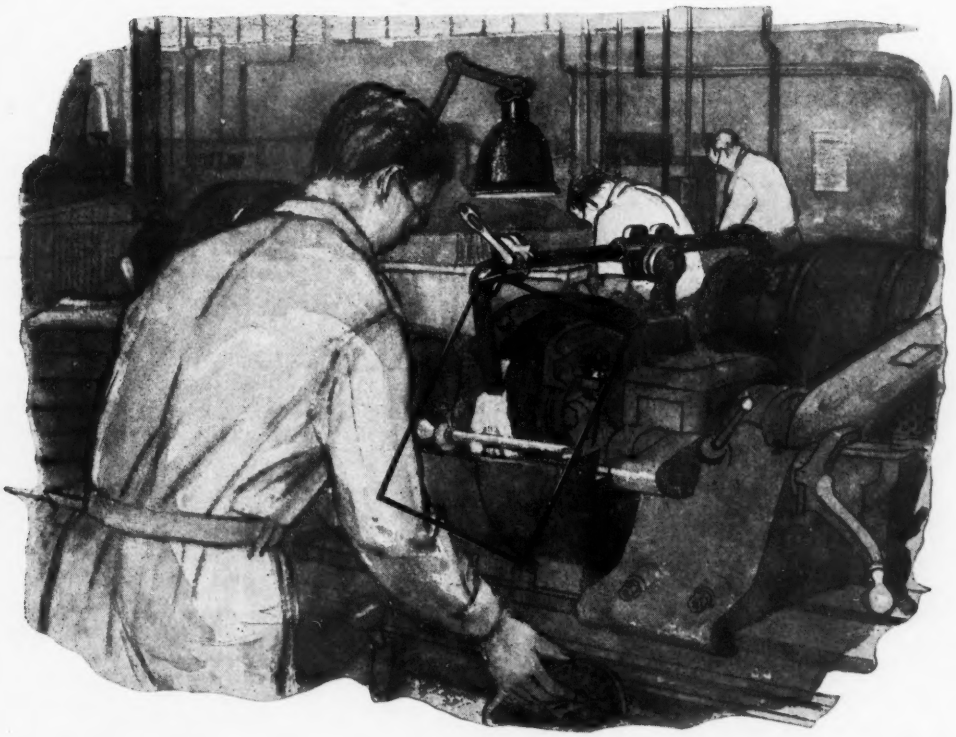

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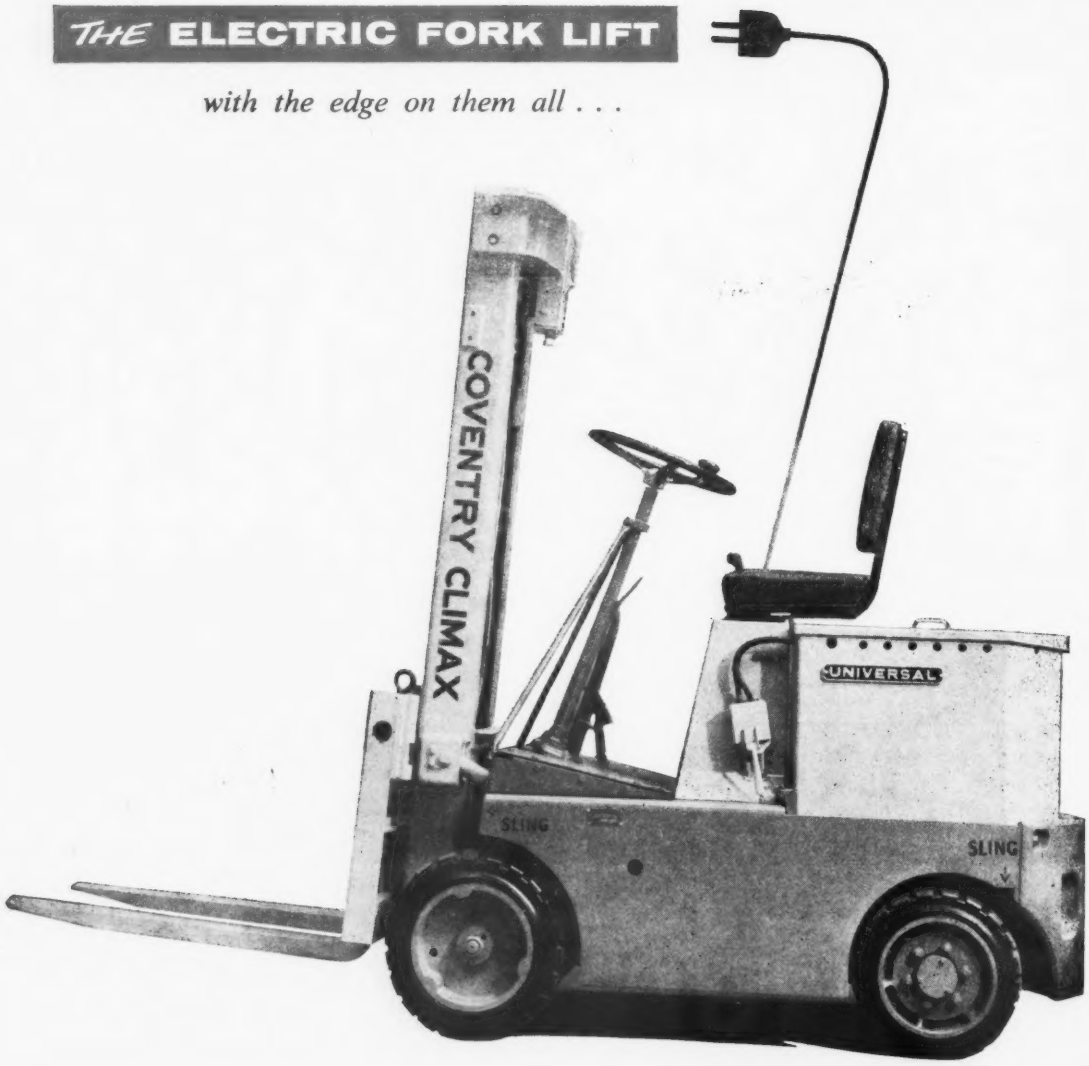

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